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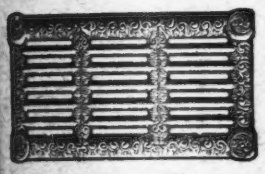

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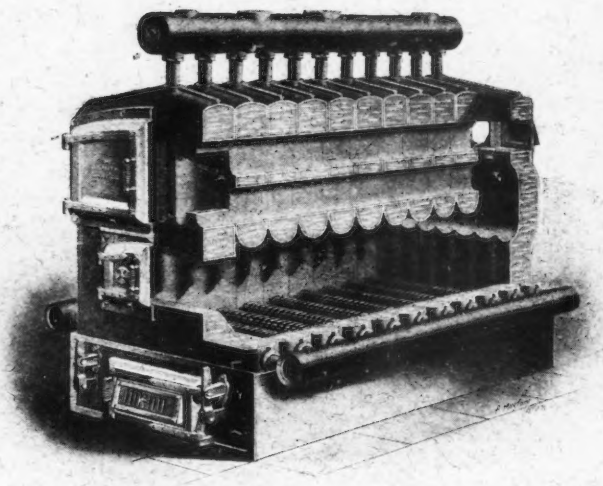

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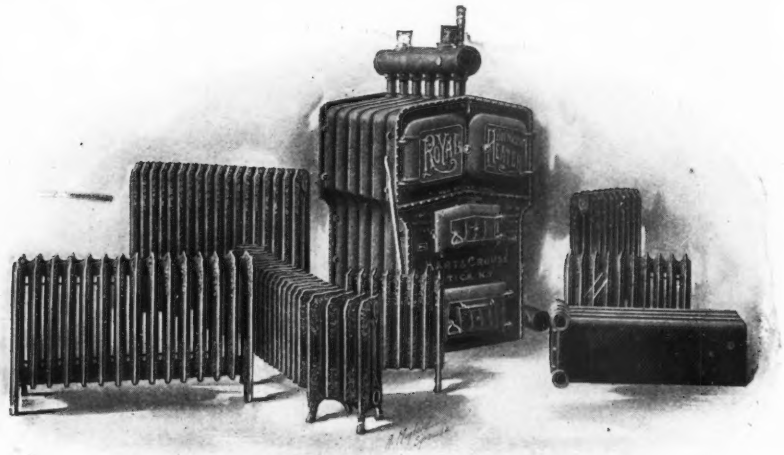


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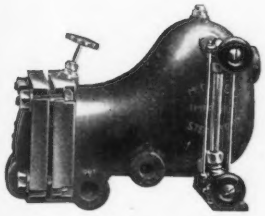

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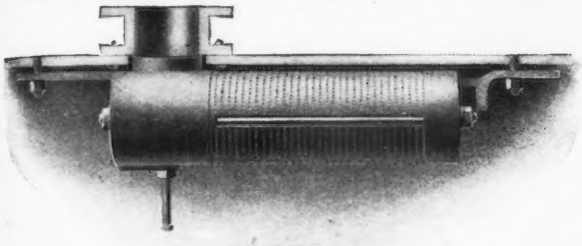

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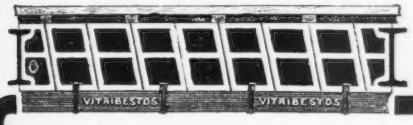


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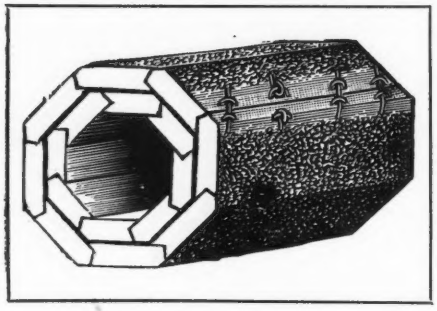

¶ Where steam pipes are in place and cannot be disconnected we furnish the Wyckoff Patent Steam Pipe Covering as shown in the accompanying cut, illustrating the manner of preparing the covering for cutting lengthwise. Remove the asphaltum coating and staple the wire on each side of the joint, as shown in cut. File or cut the wire between the staples. This will allow the outside covering to be opened. Then cut the paper on the inside shell, staple and cut wire same as outside. If this covering is to be cut in halves, remove coating, staple and cut wires at the opposite joint in the same manner.

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The same pipe enclosed in Wyckoff's Patent Steam Pipe Covering lost *only 4.2 per cent.*

# The Heating and Ventilating Magazine

VOL. V No. 5

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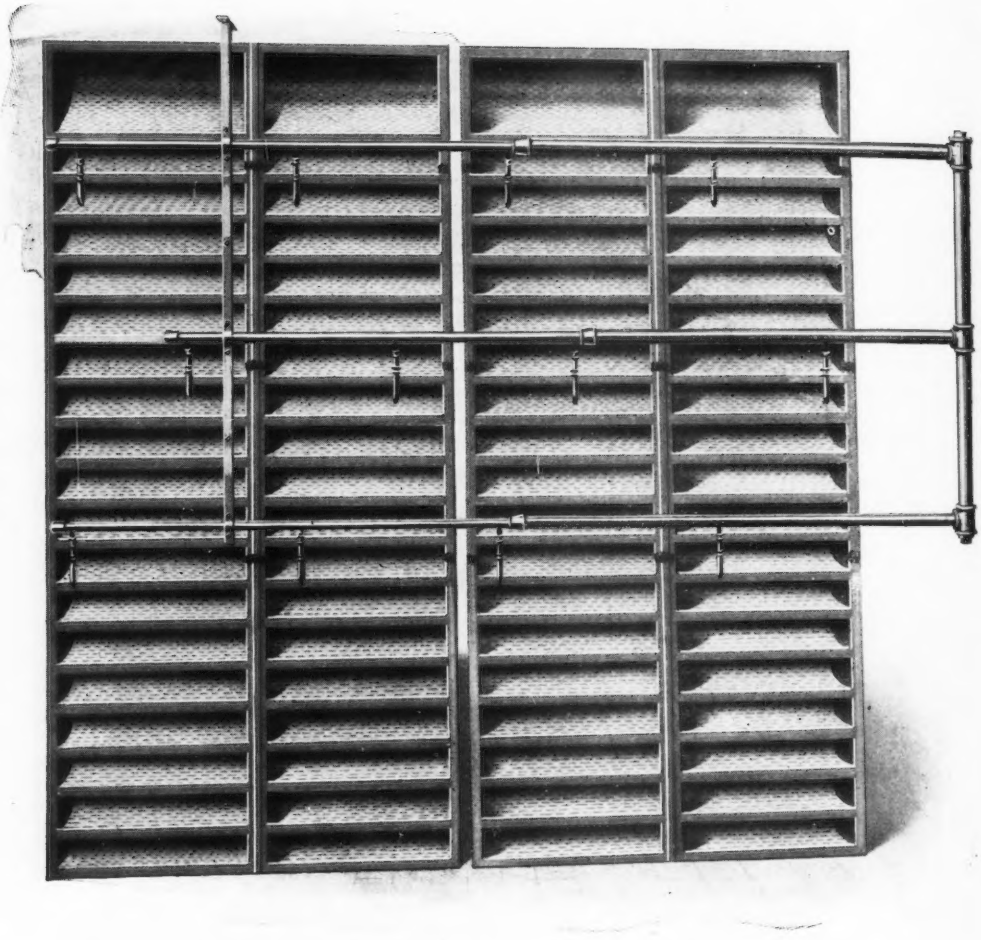

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK MAY, 1908

# Relative Capacities of Pipes

BY JOHN JAEGER

To convey or discharge a liquid through a pipe and branch it off on its run into different pipes of smaller diameter than the main pipe, but having the same combined capacity and the same friction per length of run, there are the following relations between the main and the branches:

The friction head in pipes is equal to $h = c \frac{l_1 \times v_1^2}{d \times 2g}$ in which

$l$ = length of run in feet.
$d$ = diameter of pipe in feet.
$v$ = velocity of liquid passing through pipe.
$c$ = coefficient varying with the velocity.
$2g = 64.3$.

As we assumed that the friction head in the run $l_1$ (see sketch) must be equal to the friction head on the run $l_2$, then it follows that

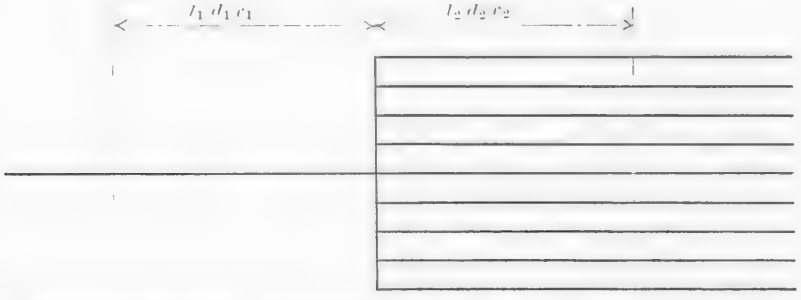
$$h_1 = c \frac{l_1 \times v_1^2}{d_1 \times 2g} \text{ and } h_2 = c \frac{l_2 \times v_2^2}{d_2 \times 2g}$$

but we assumed that $h_1 = h_2$ or

$$c \frac{l_1 \times v_1^2}{d_1 \times 2g} = c \frac{l_2 \times v_2^2}{d_2 \times 2g}$$

and written shorter and remembering that $l_1 = l_2$ there must be

$$\frac{v_1^2}{d_1} = \frac{v_2^2}{d_2} \text{ or } \sqrt{\frac{d_2}{d_1}} = \frac{v_2}{v_1}$$




SKETCH OF MAIN PIPE WITH BRANCHES OF SMALLER DIAMETER BUT HAVING SAME COMBINED CAPACITY

As an example: In how many 1-in. branches must a 4-in. pipe be divided so that the friction per length of run in either 4-in. or 1-in. pipe is the same and, of course, the capacity also?

Take the last formula and substitute for

$d_1 = 4''$; $d_2 = 1''$ and say the velocity $v_2 = 1$ unit. Then follows:

$$\sqrt{\frac{1}{4}} = \frac{1}{v_1} = 0.5 \text{ and } v_1 = 2$$

In other words the liquid passes through the 4-in. pipe twice as quickly as through the 1-in. pipe and as the capacity of a 4-in. pipe is 16

times that of a 1-in. pipe there must be 32 1-in. pipes to each 4-in. pipe to make the friction per run of length and capacity the same.

It can be seen from the last formula that any two pipe sizes can be compared and the relative velocities figured out.

---

# Data for a Heating Engineer's Handbook

COMPILED BY GERARD W. STANTON

## III.

### Capacities of Air Ducts and Registers

There are many tables published that give the same information that the following tables do, but most of them are incomplete or are lacking in some essential feature that make them inconvenient for drafting-room work.

It was the endeavor to make these tables as complete as possible and applicable to both round and rectangular duct work.

In the tables presented herewith, the areas of ducts in square inches is given for capacities from 10 to 40,000 cu. ft. air per minute at velocities ranging from 120 to 2,000 feet per minute.

Two tables of register sizes and capacities are given, that of Table I. giving the usual commercial sizes and their net area of free air opening. The table is convenient when the size of the register is known and it is desired to know the free area of the registers.

Table II. is so arranged that registers of equivalent areas are grouped together, enabling one to select a size best suited to its particular location in the system.

The net areas of the faces are figured on the basis of allowing $\frac{1}{3}$ of the total area of the face for grill and $\frac{2}{3}$ for free area of openings.

---

### Faults In a Hot Water Heating Plant

In discussing the amount of fuel that would be used in heating plants during a season, at the annual meeting of the Heating Engineers' Society, Mr. Barwick referred to a hot water heating plant he had investigated in Paterson, N. J. Following are his revised remarks on the subject:

The boiler had only 635 sq. ft. of radiating surface connected with it, but the party told me he had burned since the season started, twenty tons of coal. He asked my opinion. I told him, from the many plants I have figured and on which I based my calculations, he ought to burn thirteen tons of coal the entire season.

I looked carefully over the plant. There was only one or two faults in it. One was where he had trouble with one of the radiators. The expansion tank was placed on the flow connection and there was a dead end; the consequence was the heat backed up the other way. The two main pipes were carried on the same level and there was little variation. I found, though, that he carried the smoke pipe into the chimney from the boiler without a damper. I noticed that the galvanizing had burned off, showing a very high rate of gases passing up the chimney. I found also, with the small size of the grate, that he carried only about 4 in. of fire in the fire pot and the fire would not last long. I suggested carrying a thicker fire and making the boiler two sections longer and he could then keep more coal on.

## SQUARE INCHES AREA OF AIR DUCTS

| CU. FT. OF AIR PER MIN. | VELOCITY OF AIR FEET PER MINUTE | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 120 | 180 | 240 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1200 | 1500 |
| 10 | 12 | 8 | 6 | 4.8 | 3.6 | 2.88 | 2.6 | 2.06 | 1.8 | 1.6 | 1.44 | 1.2 | .96 |
| 20 | 24 | 16 | 12 | 9.6 | 7.2 | 5.76 | 4.8 | 4.12 | 3.6 | 3.2 | 2.88 | 2.4 | 1.92 |
| 30 | 36 | 24 | 18 | 14.4 | 10.8 | 8.64 | 7.2 | 6.18 | 5.4 | 4.8 | 4.32 | 3.6 | 2.88 |
| 40 | 48 | 32 | 24 | 19.2 | 14.4 | 11.52 | 9.6 | 82 | 7.2 | 6.4 | 5.76 | 4.8 | 3.84 |
| 50 | 60 | 40 | 30 | 24 | 18 | 14.4 | 12 | 10.3 | 9 | 8 | 7.20 | 6 | 4.80 |
| 60 | 72 | 48 | 36 | 28.8 | 21.6 | 17.28 | 14.4 | 12 | 10.8 | 9.6 | 8.64 | 7.2 | 5.76 |
| 70 | 84 | 56 | 42 | 33.6 | 25.2 | 20.2 | 16.8 | 144 | 12.6 | 11.2 | 10.08 | 8.4 | 6.72 |
| 80 | 96 | 64 | 48 | 38.4 | 28.8 | 23. | 19.2 | 16.5 | 14.4 | 12.8 | 11.52 | 9.6 | 7.68 |
| 90 | 108 | 72 | 54 | 43.2 | 32.4 | 25.9 | 21.6 | 18.5 | 16.2 | 14.4 | 12.96 | 10.8 | 8.64 |
| 100 | 120 | 80 | 60 | 48 | 36 | 28. | 24 | 20.6 | 18 | 16. | 14.4 | 12 | 9.60 |
| 110 | 132 | 88 | 66 | 52.8 | 39.6 | 31.7 | 26.4 | 22.6 | 19.8 | 17.6 | 15.8 | 13.2 | 10.56 |
| 120 | 144 | 96 | 72 | 57.6 | 43.2 | 34.6 | 28.8 | 24.7 | 21.6 | 19.2 | 17.3 | 14.4 | 11.52 |
| 130 | 156 | 104 | 78 | 62.4 | 46.8 | 37.44 | 31.2 | 26.8 | 23.4 | 20.8 | 18.7 | 15.6 | 12.48 |
| 140 | 168 | 112 | 84 | 67.2 | 50.4 | 40.32 | 33.6 | 28.8 | 26.2 | 22.4 | 20.16 | 16.8 | 13.44 |
| 150 | 180 | 120 | 90 | 72 | 54 | 43.20 | 36 | 30.8 | 27 | 24 | 21.6 | 18. | 14.40 |
| 160 | 192 | 128 | 96 | 76.8 | 57.6 | 46.08 | 38.4 | 32.9 | 28.8 | 25.6 | 23. | 19.2 | 15.36 |
| 170 | 204 | 136 | 102 | 81.6 | 61.2 | 48.96 | 40.7 | 35 | 30.6 | 27.2 | 24.5 | 20.4 | 16.32 |
| 180 | 216 | 144 | 108 | 86.4 | 64.8 | 51.84 | 43.3 | 37 | 32.4 | 28.8 | 25.9 | 21.6 | 17.28 |
| 190 | 228 | 152 | 114 | 91.2 | 68.4 | 54.72 | 45.6 | 39.1 | 34.2 | 30.4 | 27.3 | 22.8 | 18.24 |
| 200 | 240 | 160 | 120 | 96 | 72 | 57.60 | 48. | 41. | 36 | 32 | 28.8 | 24 | 19.20 |
| 210 | 252 | 168 | 126 | 100.8 | 75.6 | 60.48 | 50.4 | 43 | 37.8 | 33.6 | 30.2 | 25.2 | 20.16 |
| 220 | 264 | 176 | 132 | 105.6 | 79.2 | 63.36 | 52.8 | 45 | 39.6 | 35.2 | 31.6 | 26.4 | 21.12 |
| 230 | 276 | 184 | 138 | 110.4 | 82.8 | 66.24 | 55.2 | 47 | 41.4 | 36.8 | 33.1 | 27.6 | 22.08 |
| 240 | 288 | 192 | 144 | 115.2 | 86.4 | 69.12 | 57.6 | 49 | 43.2 | 38.4 | 34.6 | 28.8 | 23.04 |
| 250 | 300 | 200 | 150 | 120 | 90 | 72 | 60. | 51 | 45 | 40. | 36. | 30 | 24 |
| 260 | 312 | 208 | 156 | 124.8 | 93.6 | 74.88 | 62.4 | 53 | 46.8 | 41.6 | 37.4 | 31.2 | 24.96 |
| 270 | 324 | 216 | 162 | 129.6 | 97.2 | 77.76 | 648 | 55 | 48.6 | 43.2 | 38.8 | 32.4 | 25.92 |
| 280 | 336 | 224 | 168 | 134.4 | 100.8 | 80.64 | 67.2 | 58 | 50.4 | 44.8 | 40.3 | 33.6 | 26.88 |
| 290 | 348 | 232 | 174 | 139.2 | 104.4 | 83.52 | 69.6 | 60 | 52.2 | 46.4 | 41.7 | 34.8 | 27.84 |
| 300. | 360 | 240 | 180 | 144 | 108 | 86.40 | 72 | 62 | 54. | 48 | 43.2 | 36 | 28.80 |

AIR DUCTS—TABLE I

## Square Inches Of Air Ducts-

| Cu. Ft. of Air per Min | Velocity Of Air Feet Per Minute | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 120 | 180 | 240 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1200 | 1500 |
| 310 | 372 | 248 | 186 | 148.8 | 111.6 | 89.28 | 74.4 | 63.8 | 55.8 | 49.6 | 44.6 | 37.2 | 29.8 |
| 320 | 384 | 256 | 192 | 153.6 | 115.2 | 92.16 | 76.8 | 65.8 | 57.6 | 51.2 | 46 | 38.4 | 30.7 |
| 330 | 396 | 264 | 198 | 158.4 | 118.8 | 95.04 | 79.2 | 67.9 | 59.4 | 52.8 | 47.5 | 39.6 | 31.6 |
| 340 | 408 | 272 | 204 | 163. | 122.4 | 98 | 81.5 | 70. | 61.2 | 54.3 | 49. | 40.8 | 32.6 |
| 350 | 420 | 280 | 210 | 168 | 126 | 101 | 84. | 72 | 63 | 56 | 50.3 | 42 | 33.6 |
| 360 | 432 | 288 | 216 | 175 | 129.6 | 103.68 | 86.5 | 74 | 64.8 | 57.5 | 51.8 | 43.2 | 34.5 |
| 370 | 444 | 296 | 222 | 177.5 | 133.2 | 106.56 | 88.7 | 76 | 66.6 | 59 | 53.2 | 44.4 | 35.5 |
| 380 | 456 | 304 | 228 | 182 | 136.8 | 109.44 | 91. | 78 | 68.4 | 60.7 | 54.6 | 45.6 | 36.4 |
| 390 | 468 | 312 | 234 | 187 | 140.4 | 112.32 | 93.5 | 80 | 70.2 | 62.2 | 56. | 46.8 | 37.4 |
| 400 | 480 | 320 | 240 | 192 | 144 | 115.20 | 96. | 82.5 | 72 | 64 | 57.5 | 48 | 38.4 |
| 410 | 492 | 328 | 246 | 197 | 147.6 | 118. | 98.5 | 84.5 | 74 | 66 | 59 | 49.2 | 39.4 |
| 420 | 504 | 336 | 252 | 202 | 151.2 | 121 | 101. | 86.5 | 75.8 | 67.2 | 60.5 | 50.4 | 40.4 |
| 430 | 516 | 344 | 258 | 207 | 154.8 | 124 | 103 | 88.5 | 77.5 | 69 | 62 | 51.6 | 41.4 |
| 440 | 528 | 352 | 264 | 212 | 158.4 | 127 | 105 | 90.5 | 79.4 | 70.5 | 63.5 | 52.8 | 42.4 |
| 450 | 540 | 360 | 270 | 216 | 162 | 130 | 108 | 92.5 | 81. | 72. | 64. | 54 | 43.4 |
| 460 | 552 | 368 | 276 | 222 | 165.6 | 133 | 111 | 94.5 | 83 | 73.5 | 66.2 | 55.2 | 44.4 |
| 470 | 564 | 376 | 282 | 226 | 169.2 | 136 | 113 | 96.5 | 84.8 | 75.5 | 68. | 56.4 | 45.2 |
| 480 | 576 | 384 | 288 | 230 | 172.8 | 139 | 115 | 98.5 | 86.5 | 77 | 69.2 | 57.6 | 46 |
| 490 | 588 | 392 | 294 | 235 | 176.4 | 142 | 117 | 100.5 | 88.2 | 78.5 | 70.5 | 58.8 | 47 |
| 500 | 600 | 400 | 300 | 240 | 180 | 144 | 120 | 102.5 | 90. | 80 | 72 | 60 | 48 |
| 510 | 612 | 408 | 306 | 242. | 183.6 | 147 | 123 | 105 | 92 | 81.5 | 73.5 | 61.2 | 49 |
| 520 | 624 | 416 | 312 | 249 | 187.2 | 150 | 125 | 107 | 93.5 | 83 | 75. | 62.4 | 50 |
| 530 | 636 | 424 | 318 | 253 | 190.8 | 153 | 127 | 109 | 95.5 | 85 | 76.5 | 63.6 | 51 |
| 540 | 648 | 432 | 324 | 259 | 194.4 | 156 | 129 | 111 | 97. | 86.5 | 77.6 | 64.8 | 51.8 |
| 550 | 660 | 440 | 330 | 264 | 198 | 158.2 | 132 | 113 | 99 | 88 | 79 | 66 | 52.7 |
| 560 | 672 | 448 | 336 | 269 | 201.6 | 161.5 | 135 | 115 | 100.5 | 89.5 | 80.7 | 67.2 | 53.8 |
| 570 | 684 | 456 | 342 | 274 | 205.2 | 164.5 | 137 | 117.2 | 102.5 | 91.5 | 82 | 68.4 | 54.7 |
| 580 | 696 | 464 | 348 | 279 | 208.8 | 167 | 139 | 119. | 104.5 | 92.5 | 83.4 | 69.6 | 55.5 |
| 590 | 708 | 472 | 354 | 284 | 212.4 | 170 | 142 | 121.5 | 106.5 | 94.5 | 85 | 70.8 | 56.5 |
| 600 | 720 | 480 | 360 | 288 | 216 | 173 | 144 | 123.5 | 108 | 96 | 86.5 | 72 | 57.5 |

AIR DUCTS—TABLE II

## Square Inches Area of Air Ducts

| Cu. Ft. of Air Per Min. | Velocity of Air Feet Per Minute | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 120 | 180 | 240 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1200 | 1500 |
| 610 | 730 | 487 | 365 | 293 | 220 | 175 | 146 | 125 | 110 | 98 | 89 | 73 | 59 |
| 620 | 742 | 495 | 372 | 297 | 223 | 178 | 149 | 128 | 112 | 99 | 90 | 75 | 60 |
| 630 | 760 | 505 | 378 | 301 | 226 | 181 | 151 | 129 | 113 | 101 | 91 | 76 | 61 |
| 640 | 770 | 512 | 384 | 308 | 230 | 184 | 154 | 132 | 115 | 102 | 92 | 77 | 62 |
| 650 | 780 | 520 | 390 | 312 | 234 | 187 | 156 | 134 | 117 | 104 | 94 | 78 | 63 |
| 660 | 795 | 528 | 396 | 318 | 238 | 190 | 158 | 136 | 119 | 106 | 95 | 80 | 64 |
| 670 | 805 | 536 | 402 | 321 | 241 | 193 | 160 | 138 | 121 | 107 | 97 | 81 | 65 |
| 680 | 817 | 545 | 408 | 327 | 245 | 196 | 164 | 140 | 122 | 109 | 98 | 82 | 66 |
| 690 | 827 | 553 | 414 | 331 | 248 | 199 | 166 | 142 | 124 | 110 | 99 | 83 | 67 |
| 700 | 835 | 562 | 420 | 334 | 250 | 200 | 167 | 144 | 126 | 111 | 100 | 84 | 67.8 |
| 710 | 850 | 570 | 425 | 340 | 256 | 204 | 170 | 146 | 128 | 114 | 102 | 85 | 68 |
| 720 | 865 | 576 | 432 | 346 | 260 | 207 | 174 | 148 | 130 | 115 | 104 | 86 | 69 |
| 730 | 875 | 585 | 440 | 350 | 263 | 210 | 176 | 150 | 131 | 117 | 105 | 87 | 70 |
| 740 | 890 | 592 | 445 | 356 | 266 | 213 | 178 | 152 | 133 | 118 | 106 | 89 | 71 |
| 750 | 900 | 600 | 450 | 360 | 270 | 216 | 180 | 155 | 135 | 120 | 108 | 90 | 72 |
| 760 | 910 | 610 | 457 | 366 | 274 | 219 | 184 | 156 | 137 | 122 | 110 | 91 | 73 |
| 770 | 925 | 617 | 462 | 370 | 277 | 222 | 185 | 158 | 139 | 123 | 111 | 93 | 74 |
| 780 | 940 | 625 | 470 | 376 | 282 | 225 | 188 | 161 | 140 | 125 | 112 | 94 | 75 |
| 790 | 950 | 630 | 475 | 380 | 285 | 227 | 190 | 162 | 142 | 126 | 114 | 95 | 76 |
| 800 | 965 | 642 | 480 | 386 | 289 | 231 | 193 | 165 | 144 | 128 | 116 | 96 | 77 |
| 810 | 970 | 645 | 485 | 390 | 292 | 233 | 195 | 167 | 146 | 130 | 117 | 97 | 78 |
| 820 | 985 | 655 | 490 | 394 | 296 | 236 | 197 | 169 | 148 | 131 | 118 | 98 | 79 |
| 830 | 995 | 665 | 500 | 398 | 299 | 239 | 199 | 171 | 149 | 133 | 119 | 99 | 80 |
| 840 | 1010 | 670 | 505 | 403 | 302 | 242 | 202 | 173 | 151 | 135 | 121 | 101 | 81 |
| 850 | 1020 | 680 | 510 | 408 | 306 | 245 | 204 | 175 | 153 | 136 | 122 | 102 | 82 |
| 860 | 1030 | 690 | 515 | 413 | 310 | 248 | 206 | 177 | 155 | 138 | 124 | 103 | 83 |
| 870 | 1045 | 695 | 520 | 418 | 313 | 250 | 209 | 179 | 157 | 140 | 125 | 104 | 84 |
| 880 | 1055 | 706 | 530 | 422 | 317 | 253 | 211 | 181 | 159 | 141 | 127 | 106 | 85 |
| 890 | 1070 | 710 | 535 | 427 | 320 | 256 | 214 | 183 | 160 | 142 | 128 | 107 | 86 |
| 900 | 1080 | 720 | 540 | 432 | 324 | 260 | 216 | 185 | 162 | 144 | 130 | 108 | 87 |

AIR DUCTS—TABLE III

## SQUARE INCHES AREA OF AIR DUCTS

| CU. FT. OF AIR PER MIN. | VELOCITY OF AIR FEET PER MINUTE | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 240 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1200 | 1500 | 1800 | 2000 |
| 910 | 546 | 437 | 328 | 262 | 218 | 187 | 164 | 146 | 131 | 109 | 88 | 73 | 65.5 |
| 920 | 552 | 442 | 332 | 266 | 221 | 190 | 166 | 147 | 133 | 110 | 89 | 74 | 66 |
| 930 | 558 | 446 | 336 | 268 | 224 | 193 | 168 | 149 | 134 | 112 | 90 | 75 | 67 |
| 940 | 564 | 451 | 340 | 270 | 226 | 194 | 169 | 151 | 135 | 113 | 91 | 76 | 68 |
| 950 | 570 | 456 | 342 | 274 | 228 | 196 | 172 | 152 | 137 | 114 | 92 | 77 | 68.4 |
| 960 | 576 | 461 | 346 | 277 | 230 | 198 | 173 | 154 | 138 | 115 | 93 | 77.5 | 69 |
| 970 | 582 | 466 | 350 | 280 | 233 | 200 | 175 | 156 | 140 | 117 | 94 | 78 | 69.8 |
| 980 | 588 | 471 | 353 | 282 | 237 | 202 | 177 | 157 | 141 | 118 | 94.6 | 79 | 70.6 |
| 990 | 594 | 476 | 356 | 285 | 238 | 204 | 178 | 158 | 143 | 119 | 95 | 80 | 71.3 |
| 1000 | 600 | 481 | 360 | 288 | 240 | 206 | 180 | 160 | 144 | 120 | 96 | 81 | 72. |
| 1100 | 660 | 528 | 396 | 317 | 264 | 226 | 198 | 176 | 158 | 132 | 106 | 88 | 79 |
| 1200 | 720 | 516 | 432 | 346 | 288 | 249 | 216 | 192 | 172 | 144 | 115 | 96 | 86 |
| 1300 | 780 | 624 | 468 | 375 | 312 | 268 | 234 | 208 | 187 | 156 | 125 | 104 | 94 |
| 1400 | 840 | 672 | 504 | 403 | 336 | 288 | 252 | 224 | 201 | 168 | 134 | 112 | 101 |
| 1500 | 900 | 720 | 540 | 432 | 360 | 308 | 270 | 240 | 216 | 180 | 144 | 120 | 108 |
| 1600 | 960 | 768 | 576 | 461 | 384 | 329 | 288 | 266 | 230 | 192 | 153 | 128 | 115 |
| 1700 | 1020 | 816 | 612 | 490 | 408 | 350 | 306 | 272 | 244 | 204 | 163 | 136 | 122 |
| 1800 | 1080 | 864 | 648 | 519 | 432 | 370 | 324 | 288 | 259 | 216 | 173 | 144 | 130 |
| 1900 | 1140 | 912 | 684 | 548 | 456 | 391 | 342 | 304 | 273 | 228 | 182 | 152 | 137 |
| 2000 | 1200 | 960 | 726 | 576 | 480 | 411 | 360 | 320 | 288 | 240 | 192 | 160 | 144 |
| 2100 | 1260 | 1008 | 756 | 605 | 504 | 432 | 378 | 336 | 302 | 252 | 202 | 168 | 151 |
| 2200 | 1320 | 1056 | 792 | 634 | 528 | 453 | 396 | 352 | 316 | 264 | 211 | 176 | 158 |
| 2300 | 1380 | 1104 | 828 | 663 | 552 | 473 | 414 | 368 | 331 | 276 | 221 | 184 | 166 |
| 2400 | 1440 | 1152 | 864 | 691 | 576 | 494 | 432 | 384 | 345 | 288 | 230 | 192 | 173 |
| 2500 | 1500 | 1200 | 900 | 720 | 600 | 514 | 450 | 400 | 366 | 300 | 240 | 200 | 180 |
| 2600 | 1560 | 1248 | 936 | 749 | 624 | 535 | 468 | 416 | 374 | 312 | 250 | 208 | 187 |
| 2700 | 1620 | 1296 | 972 | 778 | 648 | 555 | 486 | 432 | 388 | 324 | 259 | 216 | 194 |
| 2800 | 1680 | 1344 | 1008 | 807 | 672 | 576 | 504 | 448 | 403 | 336 | 269 | 224 | 202 |
| 2900 | 1740 | 1392 | 1044 | 836 | 696 | 597 | 522 | 464 | 417 | 348 | 278 | 232 | 209 |
| 3000 | 1800 | 1440 | 1080 | 865 | 720 | 617 | 540 | 480 | 432 | 360 | 288 | 240 | 216 |

AIR DUCTS—TABLE IV

## SQUARE INCHES AREA OF AIR DUCTS

| CU. FT. OF AIR PER MIN. | VELOCITY OF AIR FEET PER MINUTE | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 240 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1200 | 1500 | 1800 | 2000 |
| 3100 | 1860 | 1488 | 1116 | 893 | 744 | 638 | 558 | 496 | 446 | 372 | 298 | 248 | 223 |
| 3200 | 1920 | 1536 | 1152 | 922 | 768 | 659 | 576 | 512 | 461 | 384 | 307 | 256 | 230 |
| 3300 | 1980 | 1584 | 1188 | 950 | 792 | 679 | 594 | 528 | 475 | 396 | 317 | 264 | 238 |
| 3400 | 2040 | 1632 | 1224 | 979 | 816 | 700 | 612 | 544 | 490 | 408 | 326 | 272 | 246 |
| 3800 | 2100 | 1680 | 1260 | 1008 | 840 | 721 | 630 | 560 | 504 | 420 | 336 | 280 | 253 |
| 3600 | 2160 | 1728 | 1296 | 1037 | 864 | 741 | 648 | 576 | 518 | 432 | 346 | 288 | 260 |
| 3700 | 2220 | 1776 | 1332 | 1066 | 888 | 762 | 666 | 592 | 533 | 444 | 355 | 296 | 267 |
| 3800 | 2280 | 1824 | 1368 | 1094 | 912 | 782 | 684 | 608 | 547 | 456 | 365 | 304 | 275 |
| 3900 | 2340 | 1872 | 1404 | 1123 | 936 | 803 | 702 | 624 | 562 | 468 | 374 | 312 | 282 |
| 4000 | 2400 | 1920 | 1440 | 1152 | 960 | 824 | 720 | 640 | 576 | 480 | 384 | 320 | 289 |
| 4100 | 2460 | 1968 | 1476 | 1181 | 984 | 844 | 738 | 656 | 590 | 492 | 394 | 328 | 296 |
| 4200 | 2520 | 2016 | 1512 | 1210 | 1008 | 865 | 756 | 672 | 605 | 504 | 403 | 336 | 303 |
| 4300 | 2580 | 2064 | 1548 | 1238 | 1032 | 885 | 774 | 688 | 619 | 516 | 413 | 344 | 311 |
| 4400 | 2640 | 2112 | 1584 | 1267 | 1056 | 906 | 792 | 704 | 634 | 528 | 422 | 352 | 318 |
| 4500 | 2700 | 2160 | 1620 | 1296 | 1080 | 927 | 810 | 720 | 648 | 540 | 432 | 360 | 325 |
| 4600 | 2760 | 2208 | 1656 | 1325 | 1104 | 947 | 828 | 736 | 662 | 552 | 442 | 368 | 332 |
| 4700 | 2820 | 2256 | 1692 | 1354 | 1128 | 968 | 846 | 752 | 677 | 564 | 451 | 376 | 339 |
| 4800 | 2880 | 2304 | 1728 | 1382 | 1152 | 988 | 864 | 768 | 691 | 576 | 461 | 384 | 347 |
| 4900 | 2940 | 2352 | 1764 | 1411 | 1176 | 1009 | 882 | 784 | 706 | 588 | 470 | 392 | 354 |
| 5000 | 3000 | 2400 | 1800 | 1440 | 1200 | 1030 | 900 | 800 | 720 | 600 | 480 | 400 | 360 |
| 5500 | 3300 | 2640 | 1980 | 1584 | 1320 | 1133 | 990 | 880 | 792 | 660 | 528 | 440 | 396 |
| 6000 | 3600 | 2880 | 2160 | 1728 | 1440 | 1236 | 1080 | 960 | 864 | 720 | 576 | 480 | 432 |
| 6500 | 3900 | 3120 | 2340 | 1872 | 1560 | 1338 | 1170 | 1040 | 936 | 780 | 624 | 520 | 468 |
| 7000 | 4200 | 3360 | 2520 | 2016 | 1680 | 1441 | 1260 | 1120 | 1008 | 840 | 672 | 560 | 504 |
| 7500 | 4500 | 3600 | 2700 | 2160 | 1800 | 1543 | 1350 | 1200 | 1080 | 900 | 720 | 600 | 540 |
| 8000 | 4800 | 3840 | 2880 | 2304 | 1920 | 1646 | 1440 | 1280 | 1152 | 960 | 768 | 640 | 576 |
| 8500 | 5100 | 4080 | 3060 | 2448 | 2040 | 1749 | 1530 | 1360 | 1224 | 1020 | 816 | 680 | 612 |
| 9000 | 5400 | 4320 | 3240 | 2592 | 2160 | 1852 | 1620 | 1440 | 1296 | 1080 | 864 | 720 | 648 |
| 9500 | 5700 | 4560 | 3420 | 2736 | 2280 | 1955 | 1710 | 1520 | 1368 | 1140 | 912 | 760 | 684 |
| 10000 | 6000 | 4800 | 3600 | 2880 | 2400 | 2057 | 1800 | 1600 | 1440 | 1200 | 960 | 800 | 720 |

AIR DUCTS—TABLE V

## SQUARE INCHES AREA OF AIR DUCTS

| CU. FT. OF AIR PER MIN. | VELOCITY OF AIR FEET PER MINUTE | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 240 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1200 | 1500 | 1800 | 2000 |
| 11000 | 6600 | 5280 | 3960 | 3168 | 2640 | 2263 | 1980 | 1760 | 1584 | 1320 | 1056 | 880 | 792 |
| 12000 | 7200 | 5760 | 4320 | 3456 | 2880 | 2469 | 2160 | 1920 | 1728 | 1440 | 1152 | 960 | 864 |
| 13000 | 7800 | 6240 | 4680 | 3744 | 3120 | 2674 | 2380 | 2080 | 1872 | 1560 | 1248 | 1040 | 936 |
| 14000 | 8400 | 6720 | 5040 | 4032 | 3360 | 2880 | 2520 | 2240 | 2016 | 1680 | 1344 | 1120 | 1008 |
| 15000 | 9000 | 7200 | 5400 | 4320 | 3600 | 3086 | 2700 | 2400 | 2160 | 1800 | 1440 | 1200 | 1080 |
| 16000 | 9600 | 7680 | 5760 | 4608 | 3840 | 3292 | 2880 | 2560 | 2304 | 1920 | 1536 | 1280 | 1152 |
| 17000 | 10200 | 8160 | 6120 | 4896 | 4080 | 3497 | 3060 | 2720 | 2448 | 2040 | 1632 | 1360 | 1224 |
| 18000 | 10800 | 8640 | 6480 | 5184 | 4320 | 3703 | 3240 | 2880 | 2592 | 2160 | 1728 | 1440 | 1296 |
| 19000 | 11400 | 9120 | 6840 | 5472 | 4560 | 3909 | 3420 | 3040 | 2736 | 2280 | 1824 | 1520 | 1368 |
| 20000 | 12000 | 9600 | 7200 | 5760 | 4800 | 4114 | 3600 | 3200 | 2880 | 2400 | 1920 | 1600 | 1440 |
| 21000 | 12600 | 10080 | 7560 | 6048 | 5040 | 4320 | 3780 | 3360 | 3024 | 2520 | 2016 | 1680 | 1512 |
| 22000 | 13200 | 10560 | 7920 | 6336 | 5280 | 4526 | 3960 | 3520 | 3168 | 2640 | 2112 | 1760 | 1584 |
| 23000 | 13800 | 11040 | 8280 | 6624 | 5520 | 4731 | 4140 | 3680 | 3312 | 2760 | 2208 | 1840 | 1656 |
| 24000 | 14400 | 11520 | 8640 | 6912 | 5760 | 4937 | 4320 | 3840 | 3456 | 2880 | 2304 | 1920 | 1728 |
| 25000 | 15000 | 12000 | 9000 | 7200 | 6000 | 5143 | 4500 | 4000 | 3600 | 3000 | 2400 | 2000 | 1800 |
| 26000 | 15600 | 12480 | 9360 | 7488 | 6240 | 5348 | 4680 | 4160 | 3744 | 3120 | 2496 | 2080 | 1872 |
| 27000 | 16200 | 12960 | 9720 | 7776 | 6480 | 5554 | 4860 | 4320 | 3888 | 3240 | 2592 | 2160 | 1944 |
| 28000 | 16800 | 13440 | 10080 | 8064 | 6720 | 5760 | 5040 | 4480 | 4032 | 3360 | 2688 | 2240 | 2016 |
| 29000 | 17400 | 13920 | 10440 | 8352 | 6960 | 5966 | 5220 | 4640 | 4170 | 3480 | 2784 | 2320 | 2088 |
| 30000 | 18000 | 14400 | 10800 | 8640 | 7200 | 6171 | 5400 | 4800 | 4320 | 3600 | 2880 | 2400 | 2160 |
| 31000 | 18600 | 14880 | 11160 | 8928 | 7440 | 6377 | 5580 | 4960 | 4464 | 3720 | 2976 | 2480 | 2232 |
| 32000 | 19200 | 15360 | 11520 | 9216 | 7680 | 6583 | 5760 | 5120 | 4608 | 3840 | 3072 | 2560 | 2304 |
| 33000 | 19800 | 15840 | 11880 | 9504 | 7920 | 6788 | 5940 | 5280 | 4752 | 3960 | 3168 | 2640 | 2376 |
| 34000 | 20400 | 16320 | 12240 | 9792 | 8160 | 6994 | 6120 | 5440 | 4896 | 4080 | 3264 | 2720 | 2448 |
| 35000 | 21000 | 16800 | 12600 | 10080 | 8400 | 7200 | 6300 | 5600 | 5040 | 4200 | 3360 | 2800 | 2520 |
| 36000 | 21600 | 17280 | 12960 | 10368 | 8640 | 7405 | 6480 | 5760 | 5184 | 4320 | 3435 | 2880 | 2592 |
| 37000 | 22200 | 17760 | 13320 | 10656 | 8880 | 7611 | 6660 | 5920 | 5328 | 4440 | 3552 | 2960 | 2664 |
| 38000 | 22800 | 18240 | 13680 | 10944 | 9120 | 7817 | 6840 | 6080 | 5472 | 4560 | 3648 | 3040 | 2736 |
| 39000 | 23400 | 18720 | 14040 | 11232 | 9360 | 8020 | 7020 | 6240 | 5616 | 4680 | 3744 | 3120 | 2808 |
| 40000 | 24000 | 19200 | 14400 | 11520 | 9600 | 8228 | 7200 | 6400 | 5760 | 4800 | 3840 | 3200 | 2880 |

## DIMENSIONS & NET AREAS OF RECTANGULAR REGISTERS

| SIZE OF OPENING | NET AREA | SIZE OF OPENING | NET AREA | SIZE OF OPENING | NET AREA | SIZE OF OPENING | NET AREA | SIZE OF OPENING | NET AREA |
|---|---|---|---|---|---|---|---|---|---|
| 4½x6½ | 20 sq | 6x30 | 120 | 9x26 | 156 | 15x25 | 250 | 22x24 | 352 |
| 4x8 | 22 | 6x32 | 128 | 9x28 | 168 | 15x30 | 300 | 22x26 | 382 |
| 4x10 | 27 | 7x7 | 33 | 9x30 | 180 | 15x34 | 340 | 22x28 | 411 |
| 4x12 | 32 | 7x10 | 47 | 10x10 | 67 | 16x16 | 171 | 22x30 | 440 |
| 4x13 | 35 | 7x12 | 56 | 10x12 | 80 | 16x18 | 192 | 22x32 | 470 |
| 4x15 | 40 | 7x14 | 66 | 10x14 | 94 | 16x20 | 214 | 22x36 | 528 |
| 4x18 | 48 | 7x15 | 70 | 10x16 | 107 | 16x22 | 235 | 22x38 | 558 |
| 4x21 | 56 | 8x8 | 43 | 10x18 | 120 | 16x24 | 256 | 22x42 | 616 |
| 4x24 | 64 | 8x10 | 54 | 10x20 | 134 | 16x28 | 299 | 24x24 | 384 |
| 5x8 | 27 | 8x12 | 64 | 10x24 | 160 | 16x30 | 320 | 24x27 | 432 |
| 5x9 | 30 | 8x13 | 70 | 11x17 | 125 | 16x32 | 342 | 24x30 | 480 |
| 5x10 | 34 | 8x14 | 75 | 11x18 | 132 | 18x18 | 216 | 24x32 | 512 |
| 5x11 | 37 | 8x15 | 80 | 11x20 | 147 | 18x21 | 252 | 24x36 | 576 |
| 5x12 | 40 | 8x16 | 86 | 12x12 | 96 | 18x24 | 288 | 24x45 | 720 |
| 5x13 | 44 | 8x18 | 96 | 12x14 | 112 | 18x27 | 324 | 27x27 | 486 |
| 5x14 | 47 | 8x21 | 112 | 12x15 | 120 | 18x30 | 360 | 27x38 | 684 |
| 5x15 | 50 | 8x24 | 128 | 12x16 | 128 | 18x36 | 432 | 28x28 | 523 |
| 5x16 | 54 | 8x27 | 144 | 12x17 | 136 | 20x20 | 267 | 28x30 | 560 |
| 5x17 | 57 | 8x30 | 160 | 12x18 | 144 | 20x22 | 294 | 28x32 | 598 |
| 5x18 | 60 | 9x9 | 54 | 12x19 | 152 | 20x24 | 320 | 28x36 | 672 |
| 6x6 | 24 | 9x12 | 72 | 12x20 | 160 | 20x26 | 347 | 30x30 | 600 |
| 6x8 | 32 | 9x13 | 78 | 12x24 | 192 | 20x28 | 374 | 30x36 | 720 |
| 6x9 | 36 | 9x14 | 84 | 12x30 | 240 | 20x30 | 400 | 30x42 | 840 |
| 6x10 | 40 | 9x15 | 90 | 12x32 | 256 | 20x32 | 427 | 30x48 | 960 |
| 6x12 | 48 | 9x16 | 96 | 12x36 | 288 | 20x36 | 480 | 36x36 | 864 |
| 6x14 | 56 | 9x17 | 102 | 14x14 | 131 | 21x21 | 294 | 36x40 | 960 |
| 6x16 | 64 | 9x18 | 108 | 14x15 | 140 | 21x25 | 350 | 36x42 | 1008 |
| 6x18 | 72 | 9x19 | 114 | 14x16 | 150 | 21x29 | 406 | 36x48 | 1152 |
| 6x20 | 80 | 9x20 | 120 | 14x18 | 168 | 21x33 | 462 | 36x38 | 912 |
| 6x22 | 88 | 9x22 | 132 | 14x20 | 187 | 21x37 | 518 | 36x40 | 1014 |
| 6x24 | 96 | 9x24 | 144 | 14x22 | 206 | 21x39 | 546 | 38x42 | 1064 |
| 6x28 | 112 | 9x25 | 150 | 14x48 | 448 | 22x22 | 323 | | |

REGISTERS—TABLE I

## NET AREAS & DIMENSIONS OF RECTANGULAR REGISTERS

| NET AREA | SIZE OF OPENING | NET AREA | SIZE OF OPENING | NET AREA | SIZE OF OPENING | NET AREA | SIZE OF OPENING | NET AREA | SIZE OF OPENING |
|---|---|---|---|---|---|---|---|---|---|
| 20 | 4½x6½ | 64 | 6x16 | 120 | 12x15 | 235 | 16x22 | 440 | 22x30 |
| 22 | 4x8 | | 8x12 | 125 | 11x17 | 240 | 12x30 | 448 | 14x48 |
| 24 | 6x6 | 66 | 7x14 | 128 | 6x32 | 250 | 15x25 | 462 | 21x33 |
| 27 | 4x10 | 67 | 10x10 | | 8x24 | 252 | 18x21 | 470 | 22x32 |
| | 5x8 | 70 | 7x15 | | 12x16 | 256 | 12x32 | 480 | 20x36 |
| 30 | 5x9 | | 8x13 | 131 | 14x14 | | 16x24 | | 24x30 |
| 32 | 4x12 | 72 | 6x18 | 132 | 9x22 | 267 | 20x20 | 486 | 27x27 |
| | 6x8 | | 9x12 | | 11x18 | 288 | 12x36 | 512 | 24x32 |
| 33 | 7x7 | 75 | 8x14 | 134 | 10x20 | | 18x24 | 518 | 21x37 |
| 34 | 5x10 | 78 | 9x13 | 136 | 12x27 | 294 | 20x22 | 523 | 28x28 |
| 35 | 4x13 | 80 | 6x20 | 140 | 14x15 | | 21x21 | 528 | 22x36 |
| 36 | 6x9 | | 8x15 | 144 | 8x27 | 299 | 16x28 | 546 | 21x39 |
| 37 | 5x11 | | 10x12 | | 9x24 | 300 | 15x30 | 558 | 22x38 |
| 40 | 4x15 | 84 | 9x14 | | 12x18 | 320 | 16x30 | 660 | 28x30 |
| | 5x12 | 86 | 8x16 | 147 | 11x20 | | 20x24 | 576 | 24x36 |
| | 6x10 | 88 | 6x22 | 150 | 9x25 | 323 | 22x22 | 598 | 28x32 |
| 43 | 8x8 | 90 | 9x15 | | 14x16 | 324 | 18x27 | 600 | 30x30 |
| 44 | 5x13 | 94 | 10x14 | 152 | 12x19 | 340 | 15x34 | 616 | 22x42 |
| 47 | 5x14 | 96 | 6x24 | 156 | 9x26 | 342 | 16x32 | 672 | 28x36 |
| | 7x10 | | 8x18 | 160 | 8x30 | 347 | 20x26 | 684 | 27x38 |
| 48 | 4x18 | | 9x16 | | 10x24 | 350 | 21x25 | 720 | 24x45 |
| | 6x12 | | 12x12 | | 12x20 | 352 | 22x24 | | 30x36 |
| 50 | 5x15 | 102 | 9x17 | 168 | 9x28 | 360 | 18x30 | 840 | 30x42 |
| 54 | 5x16 | 107 | 10x16 | | 14x18 | 374 | 20x28 | 864 | 36x36 |
| | 8x10 | 108 | 9x18 | 171 | 16x16 | 382 | 22x26 | 960 | 30x48 |
| | 9x9 | 112 | 6x28 | 180 | 9x30 | 384 | 24x24 | | 36x40 |
| 56 | 4x21 | | 8x21 | 187 | 14x20 | 400 | 20x30 | 912 | 36x38 |
| | 6x14 | | 12x14 | 192 | 12x24 | 406 | 21x29 | 1008 | 36x42 |
| | 7x12 | 114 | 9x19 | | 16x18 | 411 | 22x28 | 1014 | 38x40 |
| 57 | 5x17 | 120 | 6x30 | 206 | 14x22 | 427 | 20x32 | 1064 | 38x42 |
| 60 | 5x18 | | 9x20 | 214 | 16x20 | 432 | 18x36 | 1152 | 36x48 |
| 64 | 4x24 | | 10x18 | 216 | 18x18 | | 24x27 | | |

REGISTERS—TABLE II

# Effect of Ventilation on the Occupancy of Offices

By Reginald Pelham Bolton.

As the sanitary condition of unventilated rooms, such as offices, is dependent upon the number of human beings confined therein, the desirable amount of floor area to be occupied by or allotted to each tenant is indicated by the atmospheric condition brought about when windows and doors are closed.

The infiltration, through leakage crevices, of one change of contained air per hour is generally accepted as that which obtains in still weather, and the degree of vitiation is, after one hour, that due to the dilution of the products of respiration and exhalation with the cubical contents of the room.

It is interesting to note that for any given height of ceiling, the degrees of impurity, when plotted, form a curve sharply rising as the space is reduced below 1,800 cu. ft. of contained air, which is equivalent, at one change per hour, to the 30 cu. ft. per minute, which has been very generally adopted as a minimum air volume per person in places desirably ventilated.

The general condition of the exterior atmosphere may be taken as 0.0004 to 0.0006 $CO_2$ or 4 to 6 parts in 10,000, and this being supplied by window leakage, to the extent of one change of contents of the room per hour, the maintenance of the contents at any given degree of purity depends upon the exhalations of the occupant. This is well established at 0.6 cu. ft. of carbonic acid per hour per individual.

Thus to ensure the tenant of such a space against a condition of the contained air after one hour's confinement therein, which shall exceed any given degree of impurity, the contents become

$$0.6 \div (d - a)$$

Where d = desired degree of impurity in parts of $CO_2$; a = prior or established impurity of the outside atmosphere or air supply to the room.

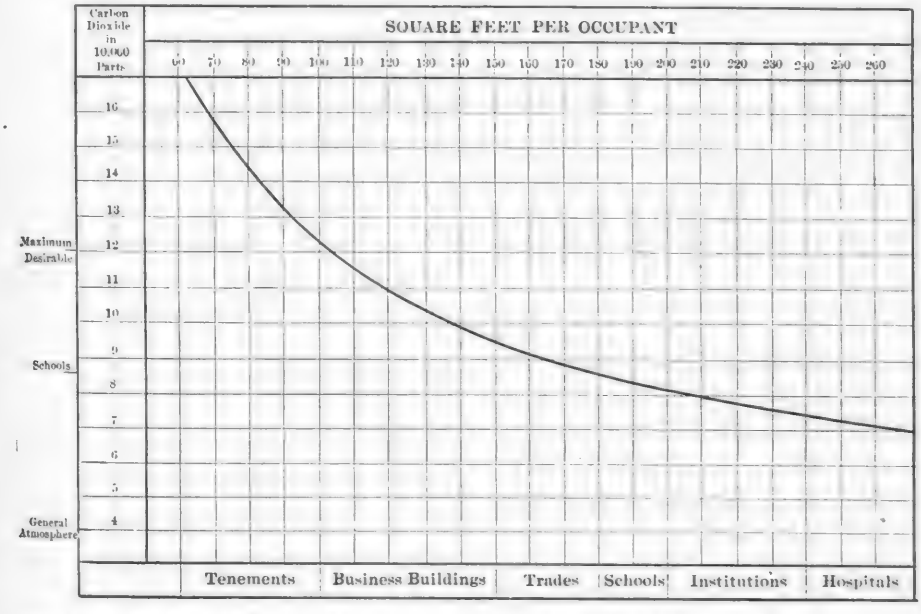



CHART SHOWING ATMOSPHERIC CONDITIONS IN CLOSED SPACES AT ONE CHANGE OF AIR PER HOUR. CEILING 10 FEET

Then where $d = 0.00075$ and $a = 0.0004$

$0.6 \div (0.00075 - 0.0004) = 0.6 \div 0.000333 = 1{,}800$ cu. ft., or where $d = 0.0012$, the maximum which should be considered, and $a = 0.0006$, which may be the case under city conditions.

$0.6 \div (0.0012 - 0.0006) = 1{,}000$ cu. ft. and for average ceiling height of 10 ft. the space becomes $180 \times 100$ sq. ft. of net occupied area per occupant.

Dr. Billings has proposed as a basis for the proper ventilation of office spaces a supply of 1,800 cu. ft. per occupant per hour and, inasmuch as the purity of this amount may be seriously encroached upon by the products of combustion of gas jets, if such exist, and to such extent by successive contamination of the outside supply, and by the exhalation of humidity from the person, it is evident that we cannot regard a less amount of space per adult than 1,000 cu. ft. as affording proper conditions for office life.

My observations have shown that there are very many closed office spaces, occupied to such an extent as to allow of about 100 sq. ft. of floor area or about 1,000 to 1,100 cu. ft. of air contents per occupant, and that these cases exist in the busiest class of office buildings, those of the stock-broking locality.

The limit thus defined has probably come about partly by the cost of land and consequent rentals, but in part also, we may suppose, by the experience of tenants. There is evidently a very good line of rates of indicated occupancy to be found in this direction, and it would certainly contribute very much to the health of tenants, and especially of their employees, if some intelligent investigation were applied to the subject by renting agents and owners.

In conclusion, I would point out that the use of efficient weather stripping is growing, and is much to be commended from the economic point of view. But it will render necessary in crowded buildings some means of providing for access of air to the occupants, and, indeed, would then have brought about a reasonable method of providing for ventilation instead of the very haphazard method, if such it can be called, of depending upon window leakage which may produce a certain result at one time and a totally different condition at another.

But as long as present conditions are maintained in business buildings it seems clear that one may find a maximum rate of occupancy due to limitations by the partial asphyxiation which follows upon too great an infraction of the laws of hygienic ventilation.

### Shrinkage of Wood in Drying

Experiments on the shrinkage of wood due to the loss of moisture have been made recently by the Forest Service at its timber testing station at Yale University. These experiments show that green wood does not shrink in drying until the moisture in it has been reduced to about one-third of the dry weight of the wood. From this point to the absolutely dry condition, the shrinkage in the area of cross section of the wood is directly proportional to the amount of moisture removed.

The shrinkage of wood in a direction parallel to the grain is so small in comparison with the shrinkage at right angles to the grain that in computing the total shrinkage in volume the longitudinal shrinkage may be neglected entirely.

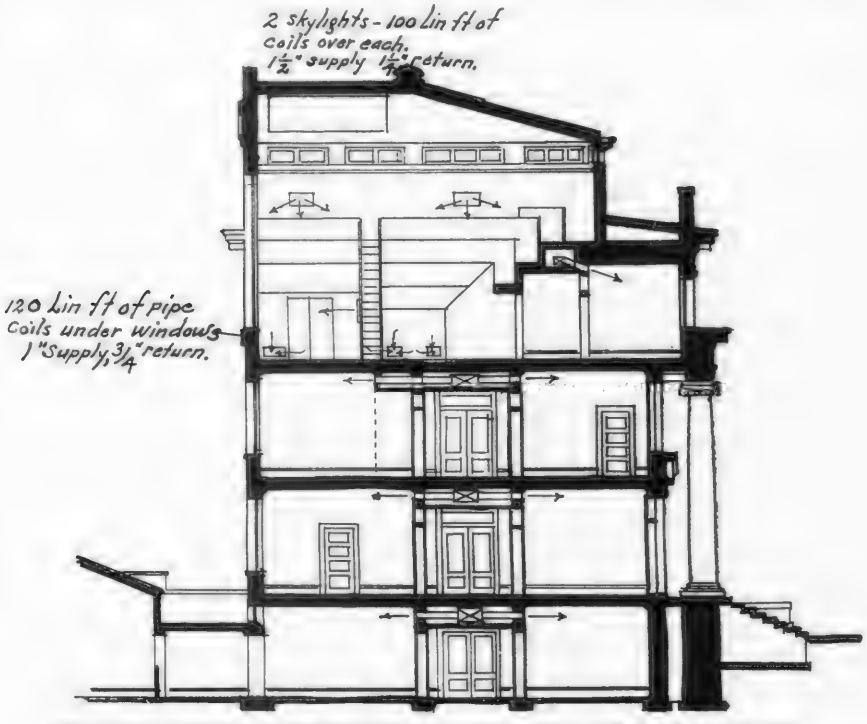
In the usual air dry condition, from 12% to 15% of moisture still remains in the wood, so that the shrinkage from the green condition to the air dry condition is but a little over half of that from the green to the absolute dry state.

Recent papers read before the Franklin Institute, Philadelphia, are "Practical Experiments in Steel," by Charles L. Huston, of the Lukens Iron and Steel Co., Coatsville, Pa., Feb. 13, and "Casting Pipes in Permanent Moulds," by Edgar A. Custer, March 26.

# Hot-Blast Heating System for a Hospital

*Equipment of the New Freedmen's Hospital Building, Washington, D. C., With Special Reference to Temperature Control*

The new Freedmen's Hospital in Washington, D. C., is a three-story and basement structure of brick and terra cotta, consisting of an administration building and four wings, connected to the main building by corridors. The wings are built at right angles to the main building, two wings being located at each end. The group occupies a space 440 ft. long by 144 ft. wide, without including the kitchen and laundry extension back of the main building. There is, in addition, a power house which will not be considered in the present description.

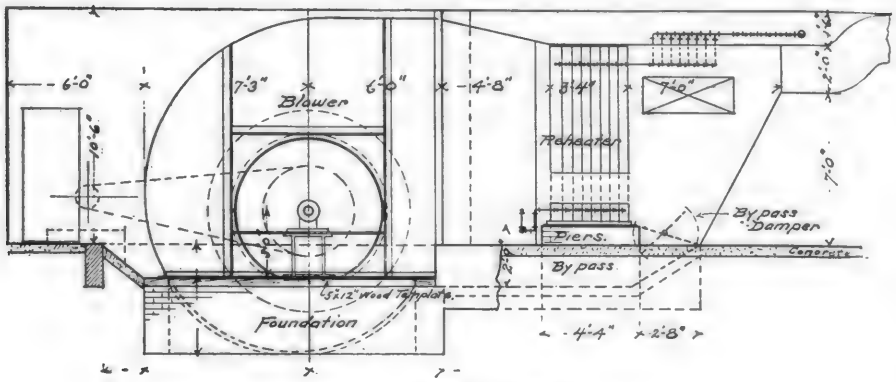



SECTION THROUGH ADMINISTRATION BUILDING, NEW FREEDMEN'S HOSPITAL, WASHINGTON, D. C.

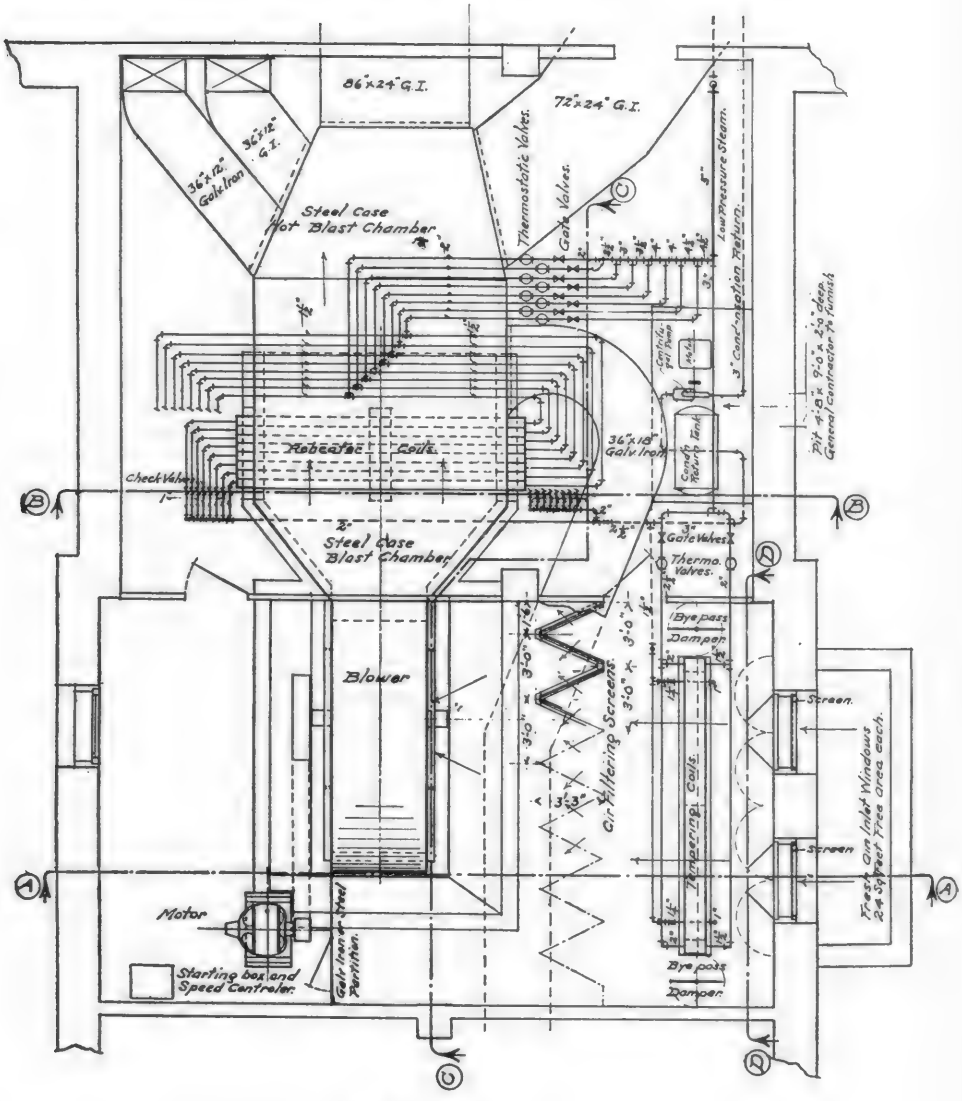
The hospital buildings, including the administration building, and the ward wings and corridors, are heated and ventilated throughout by means of the blower or hot-blast system, under thermostatic control. There are two groups of apparatus, one located in Ward Wing No. 2, and the other in Ward Wing No. 3. The apparatus groups are exactly similar, except that one blower is right-hand and the other left-hand. The details shown in the accompanying illustrations are of the apparatus group in Wing No. 2. The vitiated air is taken care of by flues leading from the various rooms to ventilating monitors on the roof.

The steam supply and return mains are carried from the power house to the administration building encased in Wyckoff log, thence on the corridor ceilings to the apparatus. The piping is continued in each wing and connected to all coils of the fan heater and tempering groups.

The tempering and reheating coils of each apparatus group are connected up into pairs. The thermostatic valves controlling the admission of steam into the groups have each a gate valve for hand opera-




SECTION ON LINE C-C




Detail Plan
Scale 1/4" = 1'-0"

DETAIL PLAN OF FAN ROOM, NEW FREEDMEN'S HOSPITAL BUILDING, WASHINGTON, D. C., SHOWING METHOD OF THERMOSTATIC CONTROL OF HEATING COILS

tion, so that the thermostatic regulation can be entirely cut out when desired.

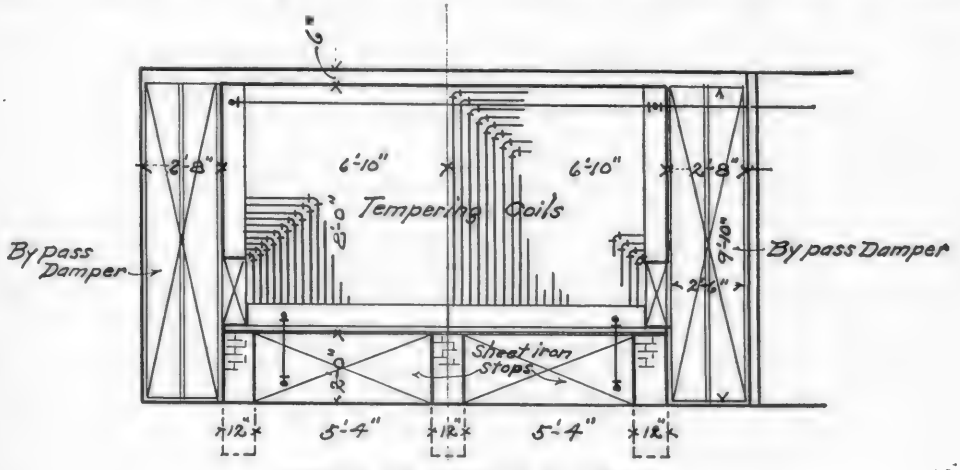
In Wing No. 2 a 1½-in. steam pipe is carried to the operating room in the north end of Wing No. 1 and connected there to 150 linear feet of skylight and window coils underneath the window and above the false skylight.

The returns from these and other coils are united and carried back in trench in the floor and united with a condensation return from the direct radiation in Wing No. 1 and carried into the return tank. The return tanks, in Wing No. 2 and Wing No. 3 are each 2 ft. in diameter by 6 ft. 6 in. long. Each tank has a 3-in. tapped opening in the bottom for return connections, a 3-in. opening in the bottom for pump suction and a 1½-in. vapor equalizer in the top. Each tank is furnished with a centrifugal pump having a capacity of 20 gals. of water per min. when operating at a speed of 1,500 R. P. M. delivering against 10-ft. head. The pumps are direct-connected to direct-current 110-volt motors.

The suction of the centrifugal pumps are taken 3 in. in size from the condensation tanks, the discharge being carried to the walls of the building and connected full-size to the condensation return mains.

Other steam connections are made for the laundry, kitchen and sterilizers in basement and third-story. There are also connections for two hot-water heaters, one in the administration building and one in the laundry.

A special steam line for supplying skylight and window coils in the main operating room and the special operating room in the third floor is carried 2 in. from the point of entrance of the 2½-in. steam line into the kitchen and laundry. It is run over the kitchen ceiling and up through a chase in the exterior wall of the administration building to the second-floor ceiling level. Here it branches horizontally and is then

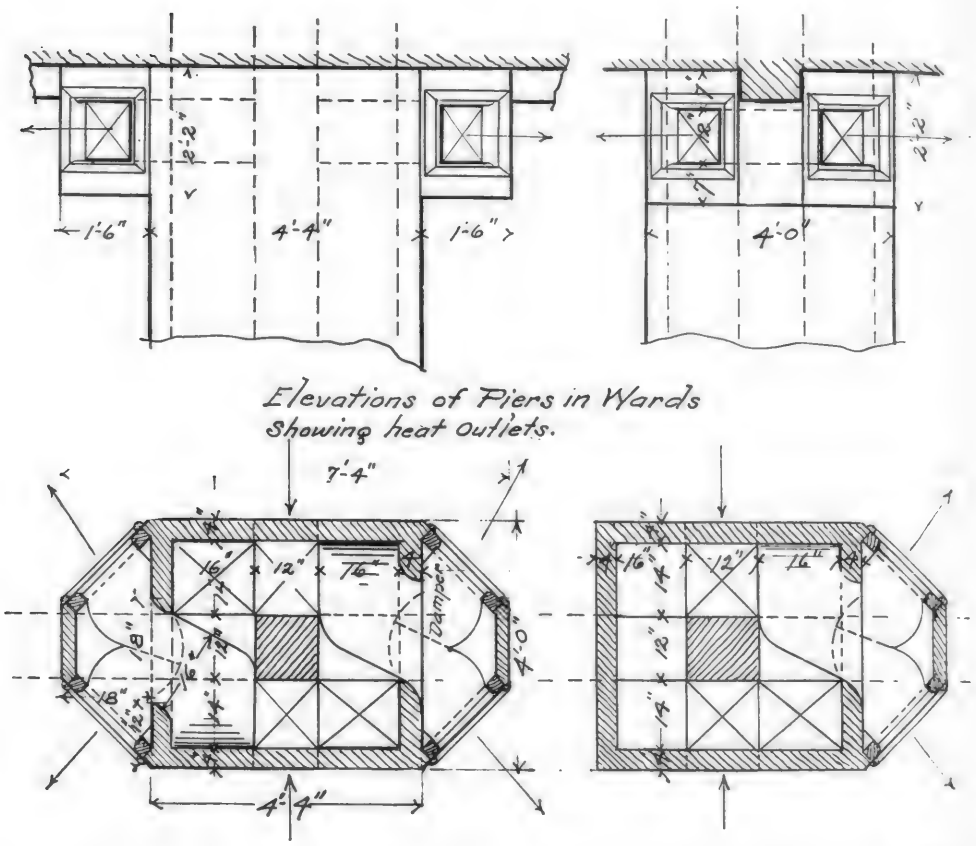



SECTION ON LINE D-D, FAN ROOM

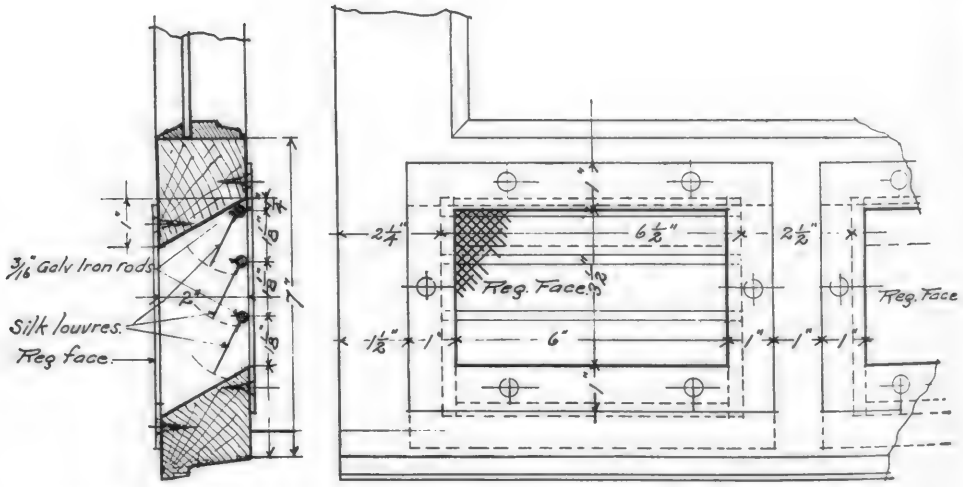
carried up to the coils.

Each tempering and reheating coil group is arranged double, as shown, the tempering coils being six rows of pipe deep and the reheating coils 16 rows deep. The coils are of the miter type and are built of 1-in. wrought-iron pipe. The tempering coils on the fan side of the tempering coil group are 4-row coils. The outside tempering coils have two rows of pipe to each coil. The total amount of heating surface for each apparatus group, including tempering and reheater coils, is 11,000 linear feet, with an actual free area of 2,600 sq. in.

The two blowers are each of the peripheral-discharge three-quarter housed steel-plate pulley fan type, with wheels 9 ft. in diameter by 4½ ft. width of case. Each fan has a ca-




DETAIL PLANS AND ELEVATIONS OF PIERS IN WARDS ON FIRST FLOOR, NEW FREEDMEN'S HOSPITAL, SHOWING HEAT AND VENT FLUES AND DEFLECTORS



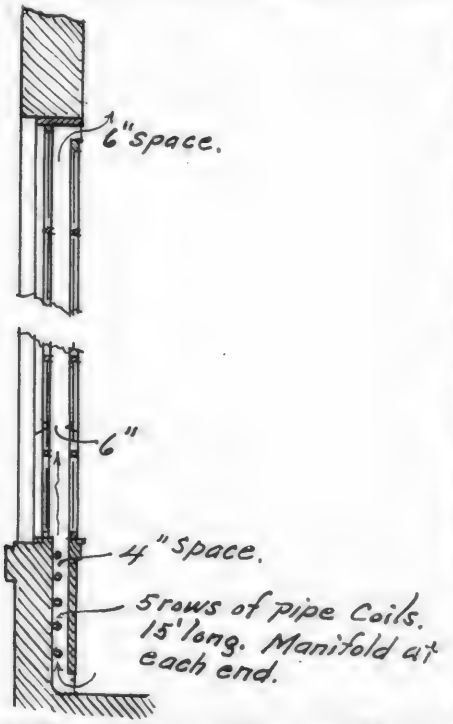

TYPICAL DETAIL SKETCH OF SASH VENTILATORS USED IN BASEMENT OF NEW FREEDMEN'S HOSPITAL BUILDING

pacity of 40,000 cu. ft. of air per min. at 135 R. P. M. They are driven by a belt-connected electric motor, each 550 volt, direct current, and are capable of speed control from 50% of full to full speed.

The accompanying illustrations show a number of details of the arrangement of the hot-blast apparatus.

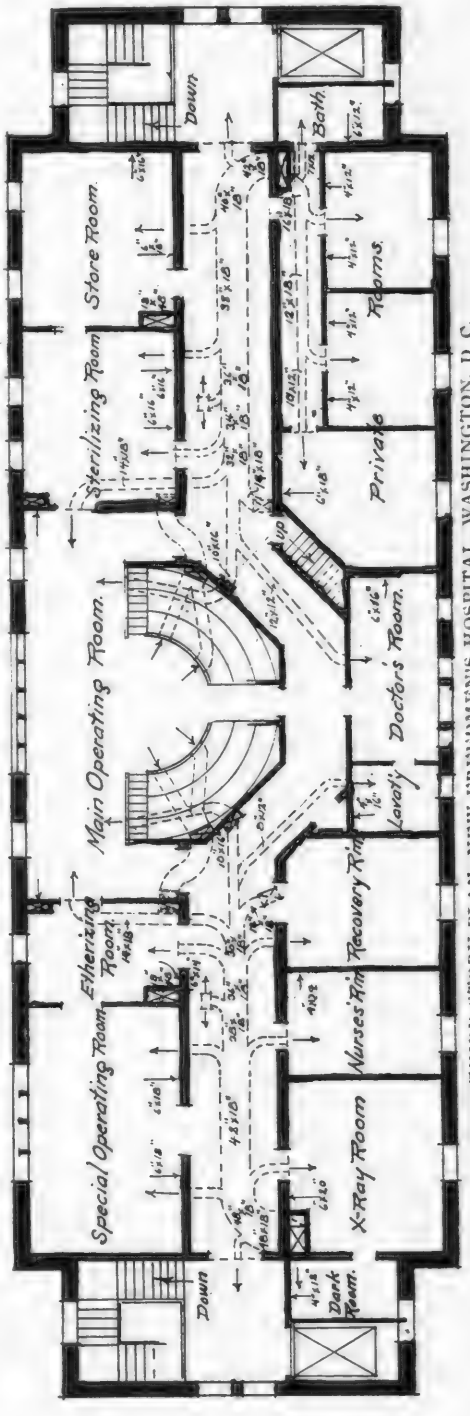
A feature worthy of more than passing notice is the arrangement of the thermostatic valves on the hot-blast coils which permits of various sections of the main heater coils and tempering coils being turned on or off to suit the requirements.

Practically every room in the entire hospital is supplied with fresh warmed air and is also ventilated. The vent flues are run independently from each room to the roof where

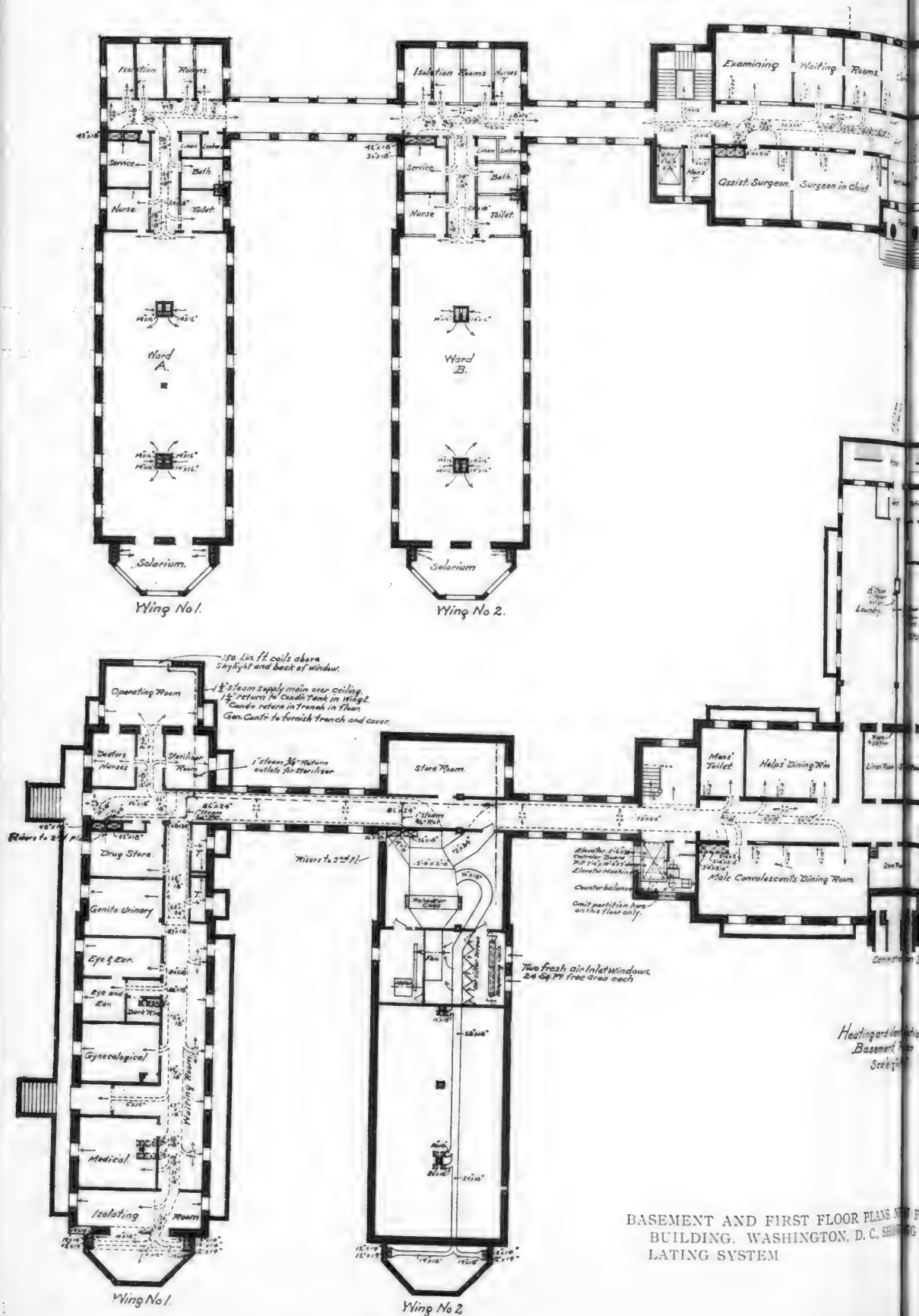



SKETCH SHOWING LOCATION OF PIPE COILS UNDER WINDOW IN OPERATING ROOM

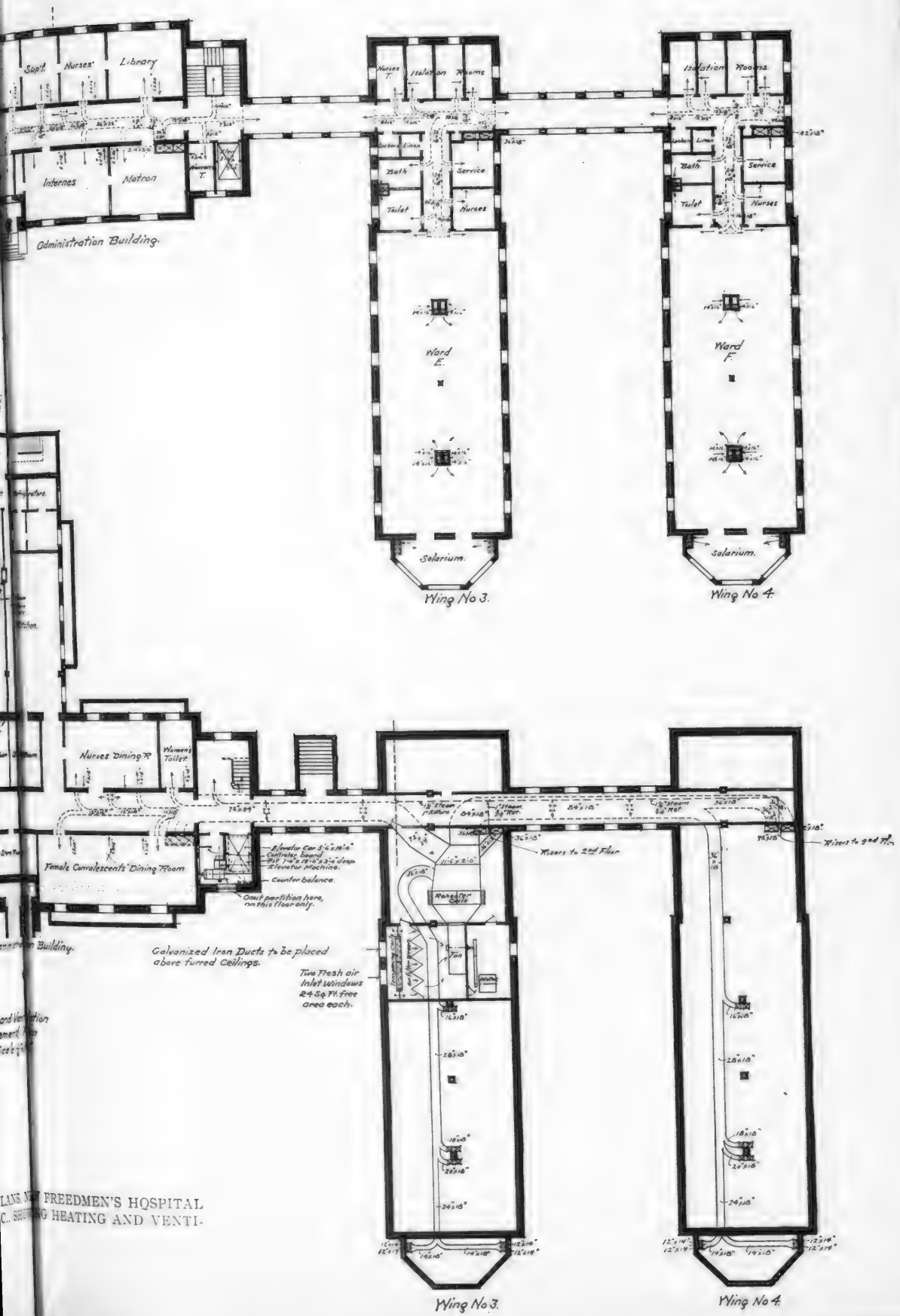
they are connected to monitor ventilators, as stated. The vent flues from the toilet rooms are carried through the roof and provided with ventilators of 16-oz. copper. All other vent flues open into the attic, being carried 18 in. above the attic floor and provided with a butterfly




THIRD STORY PLAN, NEW FREEDMEN'S HOSPITAL, WASHINGTON, D. C.



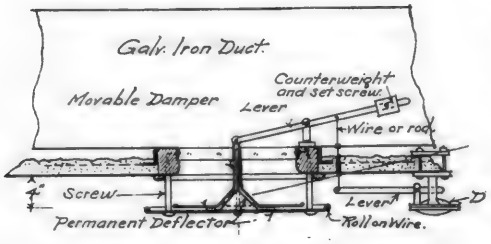

BASEMENT AND FIRST FLOOR PLANS OF [illegible] BUILDING, WASHINGTON, D. C., SHOWING HEATING AND VENTILATING SYSTEM




FREEDMEN'S HOSPITAL
HEATING AND VENTI-

damper in each. No registers or fans are used, the ducts opening directly into the rooms with sanitary moulding around the opening.

The heating of the various rooms is further regulated by means of thermostatic regulation dampers, controlled by diaphragms mounted on the wall.




DETAIL OF CEILING OUTLETS, DAMPERS AND DEFLECTORS FOR CORRIDORS IN NEW FREEDMEN'S HOSPITAL

In the basement of Ward Wing No. 1 sash ventilators are used. Register faces are placed on both sides of the sash, the face on the inside of the sash carrying oiled silk louvers. In the ventilating monitors on the roofs of the building, behind the permamanent metal louvers, removable wooden frames are furnished carrying automatic ventilating louvers such as those used for sash vents.

The architects of the buildings are Bruce, Price & De Sibour and John Russell Pope, of New York. The power plant and the heating and ventilating equipment was designed by Burt S. Harrison, New York. The contractor for the steam fitting and ventilating work was The Biggs Heating Co., acting as sub-contractors under the Fuller Company, general contractor.

---

## *Meter Rate and Flat Rate in District Steam Heating*

Can a definite relation be established between a meter rate and a flat rate for steam heating under the same conditions of service?

Should this rate be based on the number of square feet of radiation, or cubic feet of space heated, or the equivalent cubic feet of space heated?

Should customers be charged the same flat rate independent of the kind of service, or should they be classified and charged accordingly?

Theoretically a meter rate is the only equitable method of charging, but practically it may be found that a flat rate will answer the purpose fully as well. The previous failures to produce a reliable meter had until recently prevented the general adoption of this system of charging, but from the success of the past year with new meters, and with the assurance from the manufacturers of still further improvements, it is probable that the meter basis of charging will become more popular.

When electricity is sold on a flat-rate basis, the consumer invariably leaves lights burning at times when they are not needed, simply because it adds somewhat to his comfort, for generally speaking, too much light is impossible. On the other hand, too much heat is not only possible but is nearly as bad as too little, and the consumer naturally takes pains to shut off the steam when the room begins to be uncomfortable. Although there is a wide difference of opinion in regard to the amount of light required for proper illumination, it is generally conceded that the temperature of a room should not be far above or below 75° F. This would seem to form a strong argument in favor of a flat-rate system.

If a flat rate is established, it is necessary to decide whether the rate shall be based on the square feet of radiation installed, or on the cubic feet of space, or on the equivalent cubic feet of space heated, which latter case takes into consideration windows, doors, masonry walls, etc.

Numerous formulæ have been worked out to give approximately the number of square feet of radiation that should be installed to heat various sized rooms under different conditions of service. It stands to reason, however, that the quantity of steam used to heat given spaces under similar conditions will be approximately constant and independent of the amount of radiation installed, provided that enough or more than enough radiation is supplied to take care of the coldest days. This would appear to be an argument in favor of basing the flat rate on the number of cubic feet or equivalent cubic feet of space heated.

Following is a summary of the information which we have collected; it is divided into three groups and all data are from metered customers:

| Class of Service | Condensation Per Sq. Ft. of Radiation Per Day | | | Condensation Per 1000 Cu. Ft. of Space Heated Per Day | | | Ratio Cu. Ft. Space to Sq. Ft. Radiation | Av. Temp. F°. |
|---|---|---|---|---|---|---|---|---|
| | Av. | Max. | Min. | Av. | Max. | Min. | | |
| Residences | 3.83 | 5.20 | 1.79 | 51.3 | 75.2 | 27.4 | 76 | 34° |
| " | 2.49 | 2.49 | 2.49 | 34.6 | 34.6 | 34.6 | 72 | 44° |
| " | 1.69 | 3.22 | 0.54 | .. | .. | .. | .. | .. |
| Stores | 4.48 | 10.1 | 1.01 | 29.0 | 50.2 | 11.4 | 115 | 34° |
| " | 2.61 | 4.03 | 1.18 | 17.1 | 37.0 | 9.2 | 181 | 44° |
| " | 1.94 | 3.77 | 0.64 | .. | .. | .. | .. | .. |
| " | 2.32 | 3.4 | 1.8 | 20.0 | 28.5 | 13.6 | 136 | 40.5° |
| Offices | 5.02 | 7.94 | 2.13 | 51.5 | 78.0 | 24.9 | 81 | 34° |
| " | 2.92 | 3.70 | 1.73 | 25.1 | 32.2 | 19.7 | 120 | 44° |
| " | 1.56 | 1.83 | 1.19 | 26.0 | 30.4 | 19.8 | 60 | 43.5° |
| " | 2.27 | 3.62 | 0.89 | .. | .. | .. | .. | .. |
| " | 2.97 | 3.8 | 1.8 | 29.0 | 49.7 | 14.9 | 111 | 40.5° |

NOTE—While there is a large variation between maximum and minimum, it was found when making the tabulation that most of the figures ran very close to the averages given above.

The table shows that the steam consumption, as would be expected, is greatest where the average temperature is lowest and that this is an important factor to be considered in arriving at the rate to charge; that the kind of service makes a very little difference in the steam consumption, although residences seem to have a greater condensation per cubic foot of contents and a less per square foot of radiation than either stores or offices; that the results, although varying widely, are near enough to justify the establishment of a flat rate, this being on the assumption that customers will use practically the same amount of steam whether on a flat or meter rate; and, finally, that if a meter rate is established a corresponding flat rate would vary according to the length of the season and average temperature, and may be easily approximated from the figures given.—*From the report of the Committee on District Heating, W. H. Blood, Jr., Chairman, National Electric Light Association.*

## New Working Rules for Steam Fitters in Pittsburg

New working rules for employees have been adopted by the master steam fitters of Pittsburg as the result of the recent strike of journeymen in that city. The rules are as follows:

Rule 1. Eight hours' work on the job during any portion of the 24 hours shall constitute a day's work. Any excess time over the above will be paid at the rate of one and one-half time.

Rule 2. Regular working hours shall be from 8 A. M. until 12 noon, and from 12.30 P. M. until 4.30 P. M., the men to be on the job at 8 P. M. at all points within a radius of 10 miles from the Allegheny County Court House.

Rule 3. All wages shall be based on the merit of the employee, and shall be as follows: Steam fitters, from $2.75 to $4 per day, helpers, from $1.50 to $2.25 per day.

Rule 4. Workmen shall be paid double time for Saturday night, Sunday and the following legal holidays—viz., New Year's Day, Memorial Day, July 4, Labor Day, Thanksgiving and Christmas.

Rule 5. Workmen shall be paid every two weeks, on the job or at the office.

Rule 6. In going from the shop to the job, or from the job to the shop, a distance of more than 1 mile, each workman will receive his car fare.

When a workman goes directly from his home to the job, the employer will pay all car fare in excess of that incurred by the workman in going from his home to the shop.

Rule 7. When workmen are sent to points beyond the easy reach of their homes, they may at the option of the employer board at such points, the employer paying the board and excess car fare.

Rule 8. If a workman leaves his job before its completion and without the consent of his employer it shall be done at his own time and expense.

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THE POSSIBILITY of arriving at the tenant capacity of a building through a study of its ventilating facilities and the practical limitations to their occupancy due to the air conditions have been found to check up with each other to a surprising degree, according to recent investigations conducted by Mr. R. P. Bolton, of New York, and referred to in a paper on the subject on another page. Most of the types of modern buildings, Mr. Bolton finds, are designed to accommodate their occupants with a desirable amount of air space and some of these amounts are limited by special laws regulating the subject. Thus the minimum allowance of space for working people in New York State, under the Labor Law of 1897, for close city occupations, is 250 cubic feet, which with 8 feet head room, would correspond to 32 square feet of floor, and this must be increased for night work to 400 cubic feet or 50 square feet per occupant.

This provision, by the way, has been made use of by the New York State Labor Commissioner as a weapon to procure adequate factory ventilation. The necessities for hospitals call for the most liberal allowance of space, the least, if dependent only upon ordinary infiltration of air through doors and windows, being 2,400 cubic feet per occupant. Those of schools, as is generally known, are defined in a few States by law, prescribing a certain amount of air space, or air changes, per hour. This, by the Massachusetts statute, for instance, corresponds to 1,800 cubic feet per occupant, with one change of air per hour, or a floor space of 180 square feet should the ceiling height be 10 feet and no positive ventilation provided.

THE New York State Tenement House Law offers another effective means of securing the proper ventilation of tenement buildings. Here the minimum space for a sleeping-room is limited to 600 cubic feet, or, say, with a 9-foot ceiling, 66 square feet of floor, a very restricted area, to be sure, but one which, we dare say, is not always afforded such occupants. In other classes of residential buildings the floor areas per occupant, for certain classes of tenanted buildings which were included in the investigation, were found to average as follows, irrespective of height of ceiling:

| Tenements: | Square Feet |
|---|---|
| Ten-family old-law tenement.. | 80 |
| Ten-family new-law tenement.. | 121 |
| Twenty-family new-law flat.... | 180 |

Apartments:

| | |
|---|---|
| Cheap elevator apartment | 233 |
| Middle-class elevator apartment | 284 |
| High-class elevator apartment, average | 330 |
| Large, roomy elevator apartment, average | 365 |

Hotels:

| | |
|---|---|
| Cheap commercial hotel | 88 |
| Transient business hotel | 135 |
| Family transient hotel | 216 |
| Modern high-class city hotel | 243 |

In buildings used for general business purposes and offices, the rooms are not specially ventilated and receive a change of atmosphere only through leakage, at a rate which Pettenkofer and other observers have ascertained as not exceeding one change of the contents per hour. This is so far accepted as an established condition, that heating apparatus in such buildings is usually computed and designed on that basis.

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A PERSON occupying a closed space of 1,000 cubic feet, or, with a 10-foot ceiling, an area of 100 square feet, will, by respiration, in approximately one hour, reduce the air therein contained to a condition containing 12 parts of carbon dioxide in 10,000, which may be taken as the lowest recognizable standard of purity for healthful conditions. The curve in the chart published on page 11 shows the increase in impurity of the atmosphere, which corresponds with the reduction of space so occupied by one person, by which it will be seen that the maximum condition of impurity that is to be considered desirable, which is that of 12 parts of carbon dioxide per 10,000 parts of air, is reached at an occupancy of 1,040 cubic feet, which, with a ceiling height of 10 feet, is afforded by 104 square feet of floor space to each occupant.

This indicates the desirable limit of occupancy in any modern structure of the nature and conditions of a business building, and agrees, it is interesting to note, with the proportion of space to occupant which has been ascertained to exist in the busiest office buildings of New York City.

---

THE PROBABILITIES of occupants consenting to be crowded into less space, under modern conditions of business, are not great. Tenants who find their space close or stuffy soon make a change, or are compelled, by the difficulty of retaining sufficient labor, to add to the space occupied. Business offices, with which schedule operation has mainly to deal, are by reason of the large space occupied by furniture, and by the restrictions on the penetration of light, limited in the number of occupants of a given interior space.

---

A WAVE of schoolhouse investigation which has been undertaken throughout the country as a result of the Collingwood School disaster has already had an important effect in creating new work on an extensive scale for builders in general and for heating and ventilating engineers and contractors in particular. Not only have worn out or antiquated heating systems been condemned in large numbers and new plants ordered in many parts of the country, but the agitation has taken the form in some sections of a recommendation for the removal of the heating apparatus altogether from the school buildings themselves and installing it, where practicable, in separate buildings.

## The Waste of Our Fuel Resources*

By I. C. White

STATE GEOLOGIST OF WEST VIRGINIA

A simple glance at a geological map of the United States, will convince any one that nature has been most lavish to us in fuel resources, for we find a series of great coal deposits extending in well scattered fields almost from the Atlantic to the Pacific, and from the Lakes to the Gulf, while even over much of New England and the coastal plains, vast areas of peat, the primal stage of coal, have been distributed. But coal of every variety from peat to anthracite is not all of nature's fuel gifts to fortunate America. Great deposits of both petroleum and natural gas occur in nearly every State where coal exists, and in some that have no coal. What greater dowry of fuels could we ask when we find them stored for us within the bosom of our mother earth in all three of the great types, coal, petroleum and natural gas, only awaiting the tap of the pick and drill to bring them forth in prodigal abundance?

Not content with destroying our magnificent forests, the only fuel and supply of carbon known to our fore-fathers, we are with ruthless hands and regardless of the future applying both torch and dynamite to the vastly greater resources of this precious carbon which provident Nature had stored for our use in the buried forests of the distant past.

First let us consider how we have wasted natural gas, the purest form of fuel, ideal in every respect, self-transporting, only awaiting the turning of a key to deliver to our homes and factories, heat and light, and power. Even wood and coal must first be converted into gas before they will burn, but here is a fuel of which nature has given us a practical monopoly, lavish in abundance, already transmuted into the gaseous stage and stored under vast pressure to be released wherever wanted at our bidding. The record of waste of this our best and purest fuel is a national disgrace.

At this very minute this unrivaled fuel is passing into the air within our domain from uncontrolled gas wells, from oil wells, from giant flambeaus, from leaking pipe lines and the many other methods of waste, at the rate of not less than one billion cubic feet daily and probably much more.

Of the total quantity of coal we have produced since mining for commercial purposes began, amounting to about five billion tons, at least an equal amount, and possibly more, has been left in abandoned mines, and irretrievably lost. You who are unacquainted with the details of mining operations, and of the structure of coal beds will doubtless wonder how such a vast loss of fuel could take place. There are many causes for the existence of this enormous waste in the extraction of coal.

First: The individual coal bed is not all pure coal and this is especially true if it be very thick. Some of it consists of layers of sulphurous or bony coal, rich in carbon, it is true, but containing more ash, sulphur, or earthy material than first-class coal should hold: hence the purchaser objects, and refuses his patronage to the party who sends him coal that is high in ash. There being no market for such coals, the operator leaves this kind of fuel unmined if it be in either the roof or bottom of his coal bed, and if it be interstratified with the pure coal, as it frequently is, he simply throws it along with other mine refuse into the gob heaps within the mine, or piles it in the hillocks of culm containing shale, clay, and other waste material at the entrance.

The quantity of this impure coal varies from 10% to 50% in nearly every coal bed, and it would probably average 25% in all the mines of the country. This material is rich in carbon, both fixed and volatile, and when utilized through the agency of producer gas, and the gas engine, will yield much more power than the same weight of the best Cardiff or Pocahontas coal when the steam engine is the agency of conversion. Why should our great manufacturing industries permit one-fourth of our entire coal resources to be thus wasted and permanently lost, when the researches of the Technical Branch of the United States Geological Survey have fully demonstrated the practicability of converting these impure coals into great sources of power? If in all new installations provision were made for the use of gas engines, a large portion of these impure coals could be utilized, and our purer types of fuel preserved for other purposes.

Second: In the mining of coal, it is necessary to support the overlying strata over large areas of the mine in order that the coal may be even partially taken out and hence it is the common mining practice temporarily to utilize about 50% of the solid coal itself, in the shape of supporting pillars for the protection of roadways, air courses, working rooms, etc. On account of accidents, like falling roof rock, "squeezes," "creeps," "crushes," mistakes in mine engineering, bad roof, and other causes, many of these huge pillars are frequently submerged and surrounded with broken rock material and thus another large portion of every coal bed, the quantity varying from 10% to 50% is utterly lost, so that approximately 25% more of the nation's coal resources is wasted from these, largely preventable, causes.

*From an address delivered at the Conference on the Conservation of Natural Resources, at the White House in Washington, May 13, 1908.

With 50% of our coal left in the abandoned mines from which it can never be recovered except at enormous expense, one would think that the end had come to wanton destruction of our coal resources, but not so.

A third means and one of unknown extent has yet to be considered. Some of the impure layers of coal may have a still larger percentage of earthy matter, and then they become partings of shale, the fossil muds and soils borne into and spread over the ancient peat bogs by the draining streams of geologic time. These partings vary in thickness from a few inches to several feet. When thin, and not exceeding 6 to 12 in., the usual mining practice is to take them out and secure the coal, but where they attain a thickness of 18 to 24 in., their removal entails too much expense for the production of bituminous coal under present commercial conditions, and hence the parting is not removed and the underlying or overlying coal as the case may be, is left in the mine usually in such a condition as to be practically irrecoverable.

These parting shales often occur near the middle of the coal seam, and thus one-half of the bed will remain buried in mine rubbish with no possibility of ever securing its precious fuel.

Very much akin to this is another kind of waste about which we as yet cannot even approximate its extent. It is well known that in every rich coal fields several (3 to 10) beds of coal may overlie each other in the same mountain, separated by from 5 to 200 feet of rock material. It often happens that the thickest and best of the beds may underlie all the others, and hence will be the first one mined, regardless of the fact that when the overlying strata break down, some and possibly several of the higher coal beds will be so dislocated and disturbed and their areas so permeated with deadly gases from the abandoned mines below, that much of this higher coal will be lost. Just how much no one yet knows, but it is feared that the fuel waste from this source will prove large. Of course nearly all of this loss could be prevented by mining the higher beds first. Another deadly peril to deep coal mining is an incident of oil and gas reduction. Many thousands of holes have been drilled through the coal measures to reach the productive oil and gas zones below. Very many of them have found only natural gas, and unless the well was very large or a profitable market near at hand, the casing has been drawn and the well abandoned. It is greatly feared that in such cases, another great menace will be added to the coal mining industry, since these abandoned oil and gas wells which penetrate the coal measures are numbered by the thousand, and no accurate public charts of the same have ever been kept.

The same story of waste of fuel comes from every mining center. The experts of the United States Geological Survey report the quantity of fuel left unmined in the ground all the way from 40% to 70% of the total deposits.

In 1906, Pennsylvania produced 109,000,000 tons of bituminous coal, 84,000,000 of which came from the five counties of Allegheny, Fayette, Greene, Washington and Westmoreland, which hold practically all of Pennsylvania's Pittsburg coal area. In 1907 Pennsylvania produced 129,000,000 tons of bituminous coal, and in the absence of exact statistics it is safe to say that at least 100,000,000 tons of this product came from the five counties in question, and not less than 95,000,000 millions tons of it from the Pittsburg seam.

There remains unmined in Pennsylvania only eleven hundred thousand acres of this great coal bed or a total available product of eighty-eight hundred million tons of coal measured by the quantity (8,000 tons per acre) obtained by the best mining methods of a great corporation during 1907. Eighty-eight hundred million divided by 95,000,000 yields a quotient of only 93 as the number of years this fuel in the Pittsburg seam will last if the present annual production should not be increased by a single ton. But who is there to say it will not be doubled even within the next decade?

## Reginald Pelham Bolton's New Book On Elevator Service

One of the most painstaking pieces of work that has recently come to our notice is a treatise by Reginald Pelham Bolton, the well-known heating and mechanical engineer, dealing with the operating conditions and proportions of elevator service in modern buildings, with diagrams, formulas and tables for passenger travel, schedule and express operation, the relation of the elevators to the building and proportions and loads of cars. The author has gone into the subject with a degree of thoroughness that leaves little to be desired in the way of accurate information regarding the use, design, etc., of passenger elevators in modern office and other buildings. Incidentally, the author in the course of his investigation, struck upon a most interesting line of inquiry with regard to the limitations to the occupancy of office buildings due to the ventilating conditions, and this is dealt with in detail. The book is practically the first authoritative work on the subject of elevator service and as such will prove of permanent value to the architect and engineer. It is published by the author, Reginald Pelham Bolton, 527 Fifth avenue, New York, and sells at $5.00. Size, 8x11 in. Pp. 69, with two insert charts.

# CORRESPONDENCE

## Fuel Guarantees for Heating Plants Not Practicable

EDITOR HEATING AND VENTILATING MAGAZINE:

In your January, 1908, issue you refer to a letter addressed by Mr. Gustave Debesson, of Paris, France, to members of the American Society of Heating and Ventilating Engineers on the subject of French architects making an effort to have their heating engineers include in their specifications clauses guaranteeing the quantity of coal to be burned during a winter in new heating plants.

Although not myself a member of the American Society of Heating and Ventilating Engineers, it will be interesting, perhaps, to some of your readers to hear about this question as it is at present handled in Hungary, Europe.

The Hungarian Board of Trade is at present working out special conditions regarding State building contracts. The Board of Trade has invited the Central Heating Section of the Hungarian Society of Manufacturers to assist in this work and the Central Heating Section has named two representatives, the writer being one of them, to discuss all questions of specifications regarding central heating contracts.

The fuel guarantee was contained in the draft of the State building contract, but, after a long debate, it has been altogether cancelled. The special conditions of the new heating contract will not contain any fuel guarantee regarding the heating of new buildings.

The arguments of the engineers were all against the fuel guarantee on account of the difference of workmanship in buildings, the difference of weather, uncertainty of heat losses caused by the influence of wind, and uncertainty of heat losses caused by the varying habits of people in openings their windows every mornings for airing purposes. The vote of the State attorney was decisive, his position being that the fuel guarantee would give cause for so many lawsuits, which would be uncertain in their issue, that the fuel guarantee should be dropped altogether.

The writer read a paper before the Hungarian Society of Engineers and Architects last February on the subject of uniformity of specifications for the installation of heating and ventilating plants and this has resulted in the election of a committee of seven to work out such specifications. The committee has not yet finished its work, but it has been decided that the specifications to be adopted by the Hungarian Society of Engineers and Architects shall not contradict the specifications of the government. That is to say, the above-mentioned society has also dropped the fuel guarantee. This is the present state of the question in this country.

As an engineer, the writer has often had to deal with the question of fuel guarantee in his contracts in different forms. One case was in connection with a glasshouse, mentioned in THE HEATING AND VENTILATING MAGAZINE for August, 1907, where the contract stipulated a certain fuel guarantee. Neither the heating effect nor the fuel guarantee could be kept in the first year and it was only after improving the puttying of the glass that it became possible to fulfill the contract. All the tests were made at the expense of the heating firm, the fuel only being paid for by the owner, which was the government in this case. No change was made in the heating plant and it afforded, therefore, a striking example of the injustice of fuel guarantees.

In a second case only the efficiency of the boiler was guaranteed. The cost of the test was $80.00, not including water, coal, pumps and three laborers, all paid for by the owners. Each per cent. under the guarantee was to be fined $10.00, each per cent. above the guarantee to be credited with a premium of $10.00. It was a small plant, the boilers having only 370 sq. ft. of heating surface.

The first test was not successful, the efficiency being about 4% less than was guaranteed. The fault was in the chimney. It was made higher by 10 ft. and the result was that, under a new test, the boiler gave 1.7% more efficiency than was guaranteed. The second test was also paid for by the owner.

The firm had three more contracts with fuel guarantees in them, amongst them the stock exchange of Budapest, described in THE HEATING AND VENTILATING MAGAZINE for July and August, 1907. These contracts were carried through without difficulty because the fuel guarantee was safe enough. The fuel guarantee was in each case given for a whole heating season; the much more dangerous guarantee for a day or hour has never been asked.

It is a matter of fact that firms here are glad to have passed this question, and the Central Heating Section of the Hungarian Society of Manufacturers strictly forbids its members to accept in their contracts full guarantees regarding the heating of buildings. Members, however, are allowed to accept guarantees regarding the efficiency of boilers.

CHARLES KNUTH, JR.,
Member of the British Institution of Heating and Ventilating Engineers.
Budapest, Hungary, March 31, 1908.

### Cost of Electric Cooking and Heating

EDITOR HEATING AND VENTILATING MAGAZINE:

Referring to your article in the April issue entitled, "The Ideal Twentieth-Century Home," I will say that we are making a rate of five cents per K. W. for electric cooking and heating, but am afraid that the statement made by your correspondent is a little misleading, for the cost would be considerably more than for coal or gas. We have no gas here and hard coal costs $8.00 per ton and soft coal $3.25 per ton.

F. M. SINSABAUGH,
Secretary and Manager Carrollton Heat, Light and Power Co.
Carrollton, Ill.

### American Society of Mechanical Engineers

In pursuance of a policy recently inaugurated by the council of the society to extend the scope of its Proceedings, Lester G. French, late editor-in-chief of *Machinery*, has been engaged to direct the society's editorial department. Among the immediate improvements to be undertaken is the establishment of departments in the monthly Proceedings, thus providing a greater variety of technical articles of interest.

The Proceedings of the society, which in the last two years has developed into practically a monthly publication, will soon be called "The Journal of the American Society of Mechanical Engineers." Under the editorship of Lester G. French, it is planned to give the publication the status of a regular engineering magazine and to this end an advertising department will be added, E. J. Gibling having been appointed advertising manager. In order to qualify the journal for entry in the mails as second-class matter, the sum of $5.00 per year out of the dues of each member will be set aside as a subscription.

Among the papers to be presented at the semi-annual meeting of the American Society of Mechanical Engineers, to be held in Detroit, Mich., June 23-26, are "A Method of Cleaning Gas Conduits," by W. D. Mount; "A Method of Checking Conical Pistons for Stress," by Prof. George H. Shepard; "Clutches," with special reference to automobile clutches, by H. Souther; "Horse-Power, Friction losses, and Efficiencies of Gas and Oil Engines," by Prof. L. S. Marks; "Some Pitot Tube Studies," by Prof. W. D. Gregory; "The Thermal Properties of Superheated Steam," by Prof. R. C. H. Heck; "A Journal Friction Measuring Machine," by Henry Hess; "A By-Product Coke Oven," by W. H. Blauvelt; "Tests of Some High Speed Steam Engines," by F. W. Dean. There will be a symposium upon machinery for conveying materials, with papers by several authorities. The Society for the Promotion of Engineering Education and the Society of Automobile Engineers will also hold their annual meeting in Detroit at this time, which will enable members of each society to participate in the sessions of the other.

## NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

INDIANA STATE ASSOCIATION

The following officers were elected for the ensuing year at the annual convention of the Indiana State Association of Master Steam and Hot Water Fitters, held at Indianapolis in March:

President, John H. Emmert, Anderson; vice-president, John O'Donnell, Evansville; secretary, W. H. Daniels, Anderson; treasurer, George H. Kirkhoff, Indianapolis.

NEW YORK STATE ASSOCIATION

At the annual meeting of the New York State Association, held in Syracuse, May 12, new officers for 1908-1909 were elected as follows:

President, Charles A. Geoghegan, New York; vice-president, John W. Danforth, Buffalo; secretary and treasurer, Howard S. Hadden, New York; recording secretary, H. B. Gombers, New York; sergeant-at-arms, William Milligan, Rochester; board of directors, C. N. Brizse, New York; W. C. Vrooman, Schenectady, N. Y.; E. F. Joy, Syracuse; W. H. Gaylord, Binghamton; and F. H. Falls, Rochester.

NEW YORK CITY ASSOCIATION

Following are the newly-elected officers of the New York City Association of Master Steam and Hot Water Fitters:

President, Charles N. Brizse; vice-president, U. G. Scollay; treasurer, Juan A. Almirall; secretary, H. B. Gombers; board of directors: Charles N. Brizse, U. G. Scollay, Juan A. Almirall, Joseph G. Geoghegan, George A. Suter.

## AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

HEADQUARTERS AT NIAGARA FALLS

Headquarters for the forthcoming midsummer meeting of the American Society of Heating and Ventilating Engineers, to be held at Niagara Falls, July 24 and 25, next, will be at the International-Cataract Hotel. Special rates will be offered to members and guests during the meeting and a number of most enjoyable entertainment features has already been planned.

## The Weather During April

Judging from the weather reports from representative sections of the country, April, of 1908, did not differ materially, as regards weather conditions, from the Aprils of others years. In some sections the temperature was a trifle higher, Chicago showing the greatest variation, with a mean temperature for the month of 3° above normal.

CHICAGO

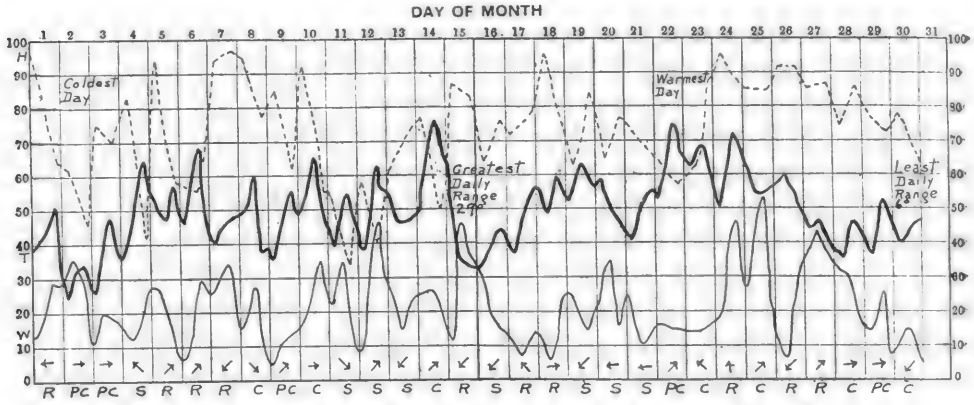
The highest temperature during April in Chicago was 76° on the 22nd and the lowest, 24° on the 2nd. The greatest daily range was 29°on the 15th and the least daily range, 6° on the 30th. Mean temperature for the month, 49°, 3° above the mean for this month for 38 years. Total rainfall, 2.81 in.; no snow. Prevailing direction of wind, southwest; total movement, 12,454 miles; average hourly velocity, 17 miles. Eight clear days, 8 partly cloudy, 14 cloudy. Rain fell on 14 days.

NEW YORK

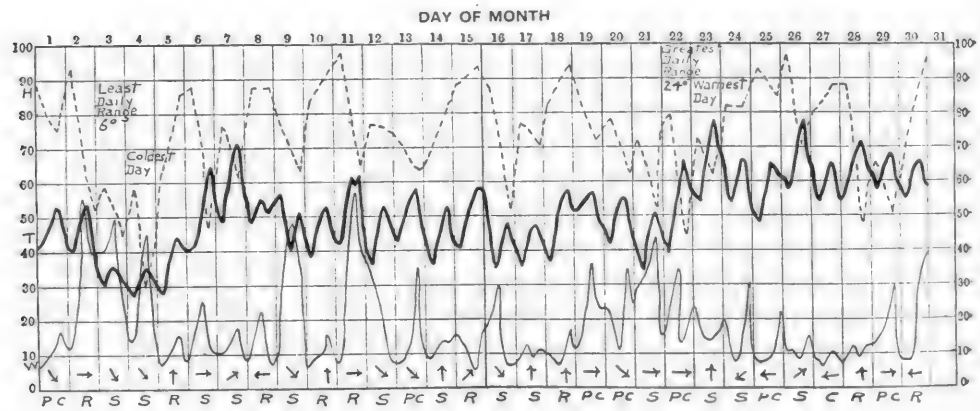
Highest temperature in New York during April, 79° on the 26th; lowest temperature, 27° on the 5th. Greatest daily range, 24° on the 22nd; least daily range, 6° on the 3rd. Mean temperature for the month, 51°, 2° above the average. Total rainfall, 1.82 in.; no snow. Prevailing direction of wind, northwest; total movement, 11,279 miles; average hourly velocity, 15.7 miles. Thirteen clear days, 11 partly cloudy and 6 cloudy. Rain fell on 10 days.

BOSTON

Highest temperature in April, 85° on the 23rd; lowest, 24° on the 4th; greatest daily range, 31° on the 23rd; least daily range, 8° on the 8th. Mean temperature for the month, 47°, 1° above the average.



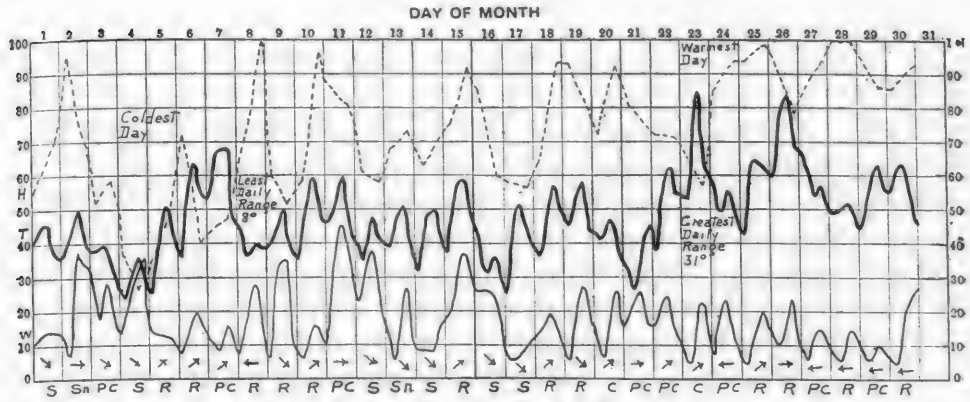

RECORD OF WEATHER IN CHICAGO FOR APRIL, 1908




RECORD OF WEATHER IN NEW YORK FOR APRIL, 1908

**Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.**

**Upper line indicates temperature in degrees Fahr.**
**Dotted line indicates relative humidity in percentage from readings taken at 8 a. m. and 8 p. m.**
**Lower line indicates velocity of wind in miles per hour**
**Arrows fly with prevailing direction of wind.**
**S—Clear. PC—Partly Cloudy. C—Cloudy. R—Rain.**


DAY OF MONTH
Coldest Day
Warmest Day
Least Daily Range 9°
Greatest Daily Range 31°
H
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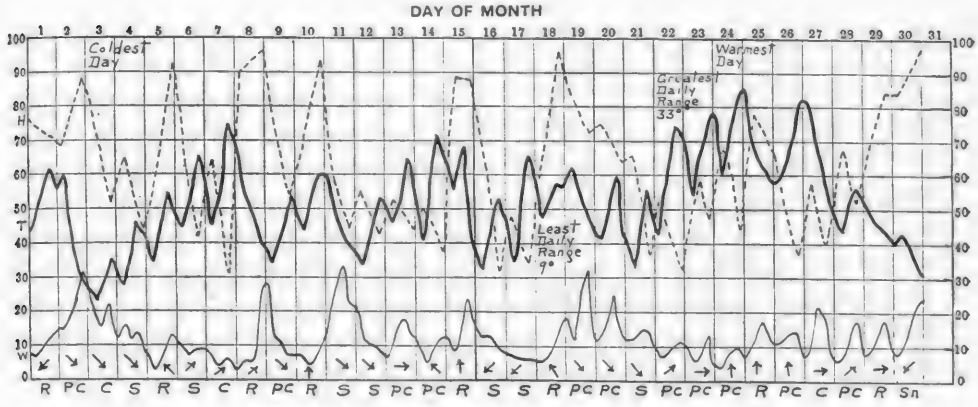
W
S Sn Pc S R R Pc R R R Pc S Sn S R S S R R C Pc Pc C Pc R R Pc R Pc R

RECORD OF WEATHER IN BOSTON FOR APRIL, 1908


DAY OF MONTH
Coldest Day
Warmest Day
Greatest Daily Range 33°
Least Daily Range 9°
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T
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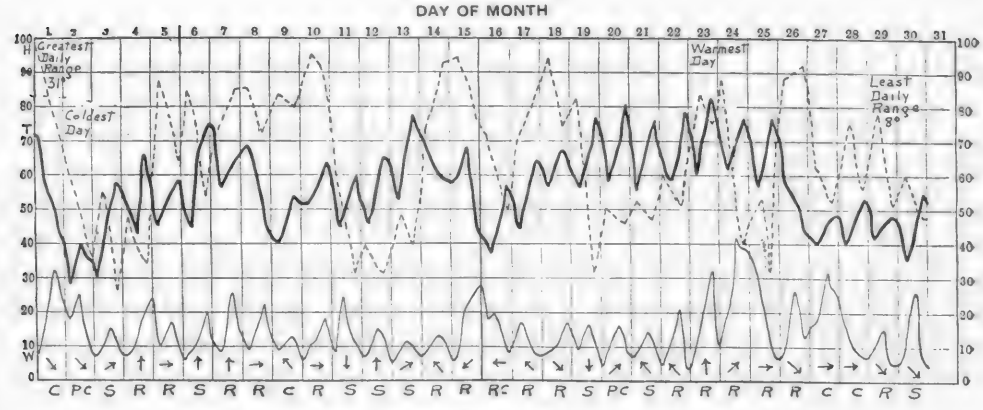
R Pc C S R S C R Pc R S S Pc Pc R S S R Pc Pc S Pc Pc Pc R Pc C Pc R Sn

RECORD OF WEATHER IN PITTSBURG, FOR APRIL, 1908


DAY OF MONTH
Greatest Daily Range 31°
Coldest Day
Warmest Day
Least Daily Range 8°
H
T
W
C Pc S R R S R R C R S S S R R R R S Pc S R R R R R C C R S

RECORD OF WEATHER IN ST. LOUIS, FOR APRIL, 1908

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Upper line indicates temperature in degrees Fahr.
Dotted line indicates relative humidity in percentage from readings taken at 8 a. m. and 8 p. m.
Lower line indicates velocity of wind in miles per hour
Arrows fly with prevailing direction of wind
S—Clear. PC—Partly Cloudy. C—Cloudy. R—Rain

Total rainfall, 1.70 in.; snowfall, 1 in. Prevailing direction of wind, northwest; total movement, 9,491 miles; average hourly velocity, 13.2 miles. Nine days clear, 11 partly cloudy, 10 cloudy. Rain fell on 15 days.

PITTSBURG

Highest temperature in Pittsburg during April, 85° on the 24th; lowest, 23° on the 3rd; greatest daily range, 33° on the 22nd; least daily range, 9° on the 18th. Mean temperature for the month, 51°, corresponding to the mean for this month for 38 years. Total rainfall, 3.59 in.; snowfall, 0.6 in. Prevailing direction of wind, northwest; total movement, 8,576 miles; average hourly velocity, 11.9 miles. Seven clear days, 11 partly cloudy and 12 cloudy. Rain fell on 10 days.

ST. LOUIS

Highest temperature for the month, 82° on the 23d; lowest, 29° on the 2nd; greatest daily range, 31° on the 1st; least daily range, 8° on the 29th. Mean temperature for the month, 56°, corresponding to the mean for this month for 36 years. Total rainfall, 3.84 in.; no snow. Prevailing direction of wind, southeast; total movement, 7,940 miles; average hourly velocity, 11 miles. Nine clear days, 6 partly cloudy and 15 cloudy. Rain fell on 16 days.

## Mine Ventilation

Something entirely new and untried, as far as a Utah metal mining property is concerned, is going to be given a test by the Silver King Coalition Mines Company. This is the better ventilation of the mine workings by means of holes driven by oil-drilling equipment.

The drilling equipment will be sent down to a depth of at least 800 feet. It all depends on the character of the formation of course, and the amount of water in the holes, as to the progress to be made in drilling, but it is expected to have the holes down within thirty days after the machinery is started. The holes are to be 12 in. in diameter, and aside from serving the purpose of ventilating shafts, they are so much more quickly constructed and so much more economical that success in this instance means the utilization of this method hereafter in a more general way.

While the use of such drill holes is an experiment in Utah, they have served the purpose admirably in the anthracite coal regions of the East.

## Boiler Scale and Its Prevention

"All water, especially surface waters, contain more or less mineral matter in solution which remains in the boiler as an encrustation when the water is boiled away or converted into steam. The mineral ingredients most commonly found in water and which cause the formation of boiler scale are the salts of calcium and magnesium. When the water is converted into steam these substances gradually separate from the solution in the form of deposits and coat the inner surface of the boiler with scale.

"Scale formation is a non-conductor of heat and the fires must therefore be driven harder to accomplish the same results. The water becomes separated from the boiler plates and the latter become overheated and are gradually burned out. The tubes and feedpipes of the boiler become more or less clogged and consequently become less efficient. Some of the scale-forming ingredients, especially magnesium chloride, also exert a corrosive action upon the iron.

"The aim of a boiler compound is to convert these substances into insoluble compounds which settle in the form of sludge or mud and can be removed from the boiler by blowing or washing.

"We could prepare a list of nearly two hundred materials which are known to have been used for boiler cleaning purposes, but there are only four of these which are worthy of mention. They are: Soda ash, or sodium carbonate; caustic soda, tannin, and kerosene.

"Soda ash is an alkali and will neutralize any acid in the water, and also precipitate salts of lime, magnesia, iron, and alumina, in the form of soft sludge, which can be easily removed when the boiler is cleaned. Caustic soda is also an alkali and neutralizes acids and aids in the precipitation of the various salts. Kerosene is used in connection with the above to prevent foaming or priming. Tannin is also used to prevent foaming or priming, and will precipitate certain mineral matters, although it is not so efficient in this respect as soda ash or caustic soda."

ARTHUR D. LITTLE.

## Trade Literature

**Ideal Water Heaters,** for heating bodies of water used for storage tanks and similar purposes, are the subject of a new catalogue issued by the manufacturers, the American Radiator Co., Chicago. The feature of the catalogue, however, which will make it an especially valuable contribution to engineering literature, are the tables and charts showing boiler capacities required to heat any quantity of water, boiler power required to heat swimming pools, and square feet of heating pipe required for storage tanks. Heretofore, as stated in the foreword, the selection of water heaters and of house-heating boilers for water-heating service has been to some extent a matter of guess-work. The company states that the tables and charts have been prepared from exhaustive tests

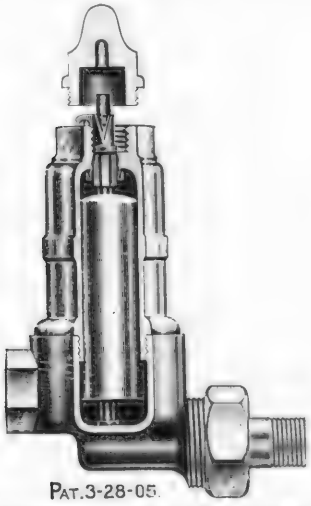
made upon each size of heater and conducted at considerable expense in the company's laboratories.

The table and chart giving boiler capacities required to heat any quantity of water cover those conditions when the specifications for tank heating are greater than the regular water-heater capacity will cover.

The catalogue is profusely illustrated, the views including typical installations of water-heaters for a variety of duties. Tabulated information is given of each size of heater's total potential energy in B. T. U. and its capacity in U. S. gallons per hour for different rises of water temperature. A price-list is also given. The catalogue shows much skill in its preparation and is a striking example of the printer's art. Size 8 x 11 in. Pp. 56.

**Multivane Fan Wheel**, for furnishing large volumes of air at high speeds, are described in a new catalogue issued by the B. F. Sturtevant Co., Hyde Park, Mass. The floats are spooned or corrugated and made shallow to retain the large inlet area.

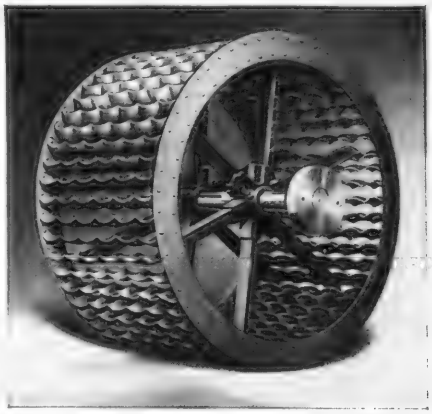
**Simonds Automatic Vacuum Valve,** as well as the other steam heat vacuum steam heating appliances, formerly owned and sold by Frank A. Simonds, Grand Rapids, Mich., and which are now controlled by the Simonds Heating and Specialty Co., Detroit, Mich., are presented to the attention of the trade in an interesting catalogue, which contains,




SIMONDS AUTOMATIC VACUUM VALVE

in addition to a description of the system, a large number of photographs of buildings in which the Simonds Vacuum System is installed, together with recent letters testifying to the success of the apparatus. The vacuum valve, which is the principal feature of the system, is an automatic device, operated by a float and being perfectly balanced by reason of the upper, or air discharge valve being of the same unbalanced area as the lower, or water discharge valve, will operate under any reasonable steam pressure or any degree of vacuum.

The vacuum of the return line extends through the hollow stem to upper float chamber and valve. The air that is carried along with the water of condensation naturally collects above the water in the dome case; and until sufficient water accumulates in the case to float the



NEW TYPE OF MULTIVANE FAN WHEEL

valves off their seats they are both tight on them.

When the float raises, the lower valve discharges the water, and the air passes through the upper valve and is drawn down through the tube that forms the stem to which both valves and the float are fastened.

The amount of air discharged, however, is regulated by an adjustable vent into this tube, which is usually about one-half of a one sixteenth-inch hole, so that no steam is wasted at this point. This amount of vent can be increased, in case radiator has a long, small feeder, or natural circulation is slow.

By means of the clamp upper valve, both valves can be adjusted tight on their respective seats after steam has been blown through them and all expansion has taken place.

The lower valve has no guide wings or pins to catch the scale and foreign matter coming along with the water, therefore when off its seat has free discharge for such, and as the opening under this valve is ½-inch diameter in the small size valve and ⅝-inch in the large size, the trouble from clogging, so usual in other vacuum valves, is reduced to the minimum. As no dirt or foreign matter can get above the water line there is no trouble of fouling even the small vent of the upper valve.

After adjustment of the valves on their seats when hot, no further attention or adjustments are needed.

**Magic Methods,** being a treatise on Magic Boiler Compound, Vulcabeston Packings in both sheet and rope form; J.-M. National Boiler Tube Cleaner; also Kearsarge Sheet Packing, Kearsarge Jointless Gaskets, are called to the attention of the trade in recently-issued circulars of the H. W. Johns-Manville Co., New York. Magic Boiler Compound acts on the tubes themselves, loosening the boiler scale.

**Underground Piping for Steam Distribution,** issued by the American District Steam Co., Lockport, N. Y., is an interesting description, prepared especially for architects and engineers of the Holly System of District Steam Heating, which is attracting special interest at this time in view of the many projects now under way in the Middle West of central station heating and lighting plants.

**Asbestos Wood,** a fire-proof substitute for wood, slate, marble and fiber for building construction and electrical insulation, is a product of the H. W. Johns-Manville Co., New York, described in a newly-issued circular containing price lists of sheets and accessories. A fire test of asbestos wood showed that in a small building constructed of this wood pyrometer readings ranging from 1,200° to 2,000° F. showed no perceptible warping of the wood and practically no heat was radiated through the structure. The wood is made principally of asbestos fiber. Another circular published by the H. W. Johns-Manville Co. illustrates and describes Asbestos Roll Fire-Felt, for use where insulation is required to resist very high temperatures. A third circular is devoted to Arido Furnace Cement, for making tight joints when used for setting up or repairing heating apparatus.

## Business Changes

**Bray Engineering Co.,** Benton, Ill., has taken over the heating and plumbing business conducted under the name of the Bray & Moore Engineering Co., H. F. Bray having purchased the interests of his former partners.

**Blumershine & Whiteman,** Gridley, Ill., have purchased the business of Niegarth & Donnelly, heating and plumbing contractors.

**Hagerstown Heating Co.,** Hagerstown, Md., has taken over the business of the Moser Heating Co., heating and plumbing contractors of that place.

**Robert W. Kyle Co.,** Wheeling, W. Va., has moved into its new building, which is 50x100 ft., brick, three stories high.

**Konrad Meier,** New York, heating and ventilating engineer, announces the removal of his office to 122 East Twenty-fifth street.

**Bride, Grimes & Co.,** 526 Essex street, Lawrence, Mass., succeeds W. F. Rutler & Co., dealers in mill, heating, plumbing and gas supplies. W. F. Rutler retires, the business being continued by the partners, James H. Bride and E. Eben Grimes.

**Siloam Springs Plumbing & Heating Co.** has purchased the stock and business of the Ozark Plumbing and Heating Co., at Siloam Springs, Ark.

**Charles L. Pillsbury,** late of Claussen, Burch & Pillsbury, Minneapolis, Minn., has opened offices at 206 Metropolitan Life Building, Minneapolis, as consulting engineer for the design and supervision of the mechanical equipment of buildings.

**John Redman Co., Inc.,** Fishkill Landing, N. Y., has taken over the heating and plumbing business conducted by John Redman up to the time of his death in May, 1907. President, Manning K. Eyre; secretary and treasurer, R. R. Eyre; manager, W. H. Deisseroth. Capital stock, $10,000.

**James Hay Co.,** heating and plumbing engineers, Pittsburg, will discontinue its business as soon as its lease, good-will and stock on hand can be disposed of. James Hay will devote his entire time to the business of the Ruud Mfg. Co., of which he is president.

**Folsom-Webster Co.,** heating and plumbing contracting firm, Pittsburg, Pa., has dissolved partnership. J. H. Folsom will have charge of the Cincinnati branch of the Ruud Mfg. Co., manufacturer of instantaneous water heaters.

**E. G. Whitacre Boiler Co.,** Pittsburg, Pa., has passed into the hands of J. E. Barnes, J. C. DeNoon and I. N. DeNoon, all of Pittsburg, who will continue the business of the company as manufacturers of hot water boilers, radiators, etc.

**Schindler & Co.,** Pittsburg, have taken over the heating and plumbing business conducted by McGinness & Co., at 138 Ninth street.

**Champion & Keys,** of St. Louis, have succeeded to the heating and plumbing business conducted by L. P. Williams at 1531 Third street, Dayton, O.

**Charles Day,** Fairbury, Ill., has purchased the heating and plumbing business of Walton Bros. Co., at that place.

**H. W. Johns-Manville Co.'s** business interests in Detroit and the territory adjacent thereto, have increased to such an extent that a new branch is about to be opened by that company. This branch will be located at 72 Jefferson avenue, Detroit, under the management of Willard K. Bush. Mr. Bush is well-known throughout that section, having been connected with the Milwaukee branch of the company for a number of years.

# TRADE AND MISCELLANEOUS NOTES

### Coming Events

Summer meeting, American Society of Mechanical Engineers, Detroit, Mich., June 23-26, 1908.

Annual convention, National Association of Master Steam and Hot Water Fitters, Boston, Mass., June 15-18, 1908. Headquarters at Hotel Brunswick, Copley Square.

Annual convention, National Association of Master Plumbers, Boston, Mass., July 14-16, 1908. Headquarters at Hotel Lenox.

Summer meeting, American Society of Heating and Ventilating Engineers, Niagara Falls, July 24-25, 1908.

### Deaths

**William K. McGinness,** vice-president of the American Warming and Ventilating Co., Pittsburg, Pa., well-known in the heating trade, died at his home in Pittsburg, April 3. He was 67 years old. He was one of the organizers of the well-known Pittsburg contracting firm of McGinness-Smith Co., of which he was vice-president and general manager. He is survived by a widow and three children.

**Henry Schlemmer,** father of C. T. and Oliver Schlemmer of the Oliver Schlemmer Co., Cincinnati, O., died at his home in that city April 15.

### Manufacturers' Notes

**Brien Heater Co.,** Springfield, Mass., is building a brick addition to its plant, 50 feet square.

**National Regulator Co.,** Chicago, has moved its New York Office to 12 East Forty-second street.

**Bay State Brass Co.,** Haydenville, Mass., announces the election of Frederick C. Smith as treasurer of that company.

**Youngstown Furnace & Supply Co.,** Youngstown, O., has increased its capital stock from $50,000 to $100,000.

### Miscellaneous Notes

**Ogden, Utah.**—The city council has passed a resolution requiring the city engineer to consult a specialist regarding the cost of erection and maintenance of a central heating plant from which heat can be supplied to all the city buildings, doing away with a separate heating plant for each building.

**Richmond, Va.**—Fire damaged the heating and lighting plant at Washington and Lee University, April 10, to the extent of $5,000, partially covered by insurance.

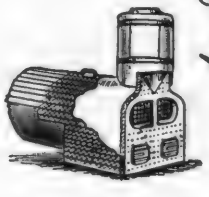
**Farmington, Ill.**—A franchise has been granted to a Canton, Ohio, company, in which Alexander Mason is interested, to build and operate a central steam heating plant in Farmington.

**Davenport, Ia.**—The Ginger Club of that place is discussing a heating proposition for the entire block in which it is located.

**Peoria, Ill.**—People's Gas & Electric Light Co., which has recently extended its mains to supply steam heat to the Graham Hospital, is negotiating to furnish heat to the high school building also.

**Ogden, Utah.**—The Board of Education proposes to remove the heating plants from the schools to separate buildings and thus minimize the danger from fire and give additional room.

TELEPHONE CALL 6097 FRANKLIN.



ESTIMATES FURNISHED AND CONTRACTS EXECUTED.

ROBERT A. KEASBEY CO.

HEAT AND COLD INSULATING MATERIALS

HEADQUARTERS FOR
85% MAGNESIA, ASBESTOS AND BRINE
PIPE COVERINGS, ASBESTOS PRODUCTS, ETC.

100 NORTH MOORE ST, NEW YORK CITY.

**Chelsea, Mass.**—Among the steam fitting firms affected by the fire which swept Chelsea recently are the following: A. P. McHatton & Co., George F. Peck Mfg. Co., and O. E. Pettman & Co. Others who suffered losses were The Buckley Trap Co., and, among the plumbing concerns, Cusher & Armstrong, H. Kent & Son, A. K. Mann & Co., and Isaac J. Walters & Co.

**Building Operations** in March showed a decrease in each section, except the South, over the figures for the corresponding period for 1907. In the Eastern cities, the decrease was 58%; Middle West, decrease 25%; Southern, increase 54%; and Pacific Coast, decrease 42%. In New York City the figures fell from $15,723,818 to $4,782,090.

**Machinery Club** of New York has moved into its new quarters in the Hudson Terminal Building, 50 Church street. A house-warming celebration will be held May 21.

**National Architectural Exposition** will hold its first exhibition during the week of September 14-19, 1908, at the Madison Square Garden, New York. The forthcoming exposition, it is said, will be a radical departure from the usual forms of exhibitions and will embrace all departments in architecture, engineering, painting, sculpture, the trades, manufacturing and craftsmanship pertaining to the construction, equipment and decoration of houses buildings. Alfred Chasseaud, general manager, 1 Madison avenue, New York, is in charge of the arrangements.

**St. Petersburg, Russia.**—Additional information concerning the International Arts and Building Exposition to be held in St. Petersburg, beginning in December next, is furnished by Ambassador Baron Rosen, who states that American engineers, architects and manufacturers are invited to take part, as it is very much desired to have a special section of American products. The exposition will include the following sections: Building material; locks, cabinetwork, wainscoting, etc.; sanitation and heating equipment; fire prevention; mechanical devices, such as electric motors and elevators; exterior and interior decoration of houses; and literature and instruction, including instruments, etc.

**Argentine Government** is making preparations for the establishment of a permanent Educational Museum in Buenos Aires, in which a large section will be devoted to school architecture and kindred subjects, including heating and ventilating apparatus. Ernesto Nelson, special commissioner of education from the Argentine Republic, is at present in New York in the interest of the movement.

### New Incorporations

**Wallingford Plumbing & Heating Co.,** Wallingford, Conn. Capital stock, $10,000. Incorporators, John P., Edward L. and Thomas J. Bowe.

**C. H. Babb & Co.,** Bangor, Me. Capital, $25,000, to conduct a heating, plumbing and lighting business. President, C. H. Babb; treasurer, R. H. Downing.

**Standard Plumbing Co.,** Akron, O. Capital, $5,000, to conduct a heating and plumbing contracting business. Incorporators, Frank E. Chalker, John C. Klein, H. C. Knecht, Frank G. Schafer and George W. Schlutz, all of Akron.

**National Valve & Mfg. Co.,** Pittsburg, Pa., incorporated to manufacture and deal in valves and other steam fitting supplies. Incorporators, Edward Lauer, Thomas Donaldson and Ralph L. Smith.

**Foster & Glidden Engineering Co.,** Buffalo, N. Y., capital $50,000, to conduct a business as heating and ventilating designing and contracting engineers. Incorporators, Charles B. Foster, J. P. Clifton and V. H. Chapman, all of Buffalo.

**Kaltens-Frank Co.,** Schenectady, N. Y., incorporated to conduct a heating and plumbing contracting business and jobbing of brass and copper work. Incorporators, Peter Kaltens, Carl Frank and A. T. G. Kemple, all of Schenectady.

**Stuart W. Cramer Co.,** Charlotte, N. C., capital $100,000, to manufacture air moisteners and ventilating apparatus. Incorporators, Stuart W. Cramer, John T. Cramer and others.

**Cummings Patent Furnace Construction Co.,** Jersey City, N. J., capital $150,000, to manufacture boilers and furnaces. Incorporators, H. O. Coughlan, L. H. Gunther and J. R. Turner, all of Jersey City.

**F. G. Grote Mfg. Co.,** Evansville, Ind., capital $50,000, to manufacture heating appliances and power machinery. Directors, P. Grote, Emil Grote and J. D. Carmody.

**Stahl-Brant Plumbing Co.,** Connellsville, Pa., heating and plumbing contractors, incorporated to take over the business of Stahl & Downing. Incorporators, Edward Stahl, Samuel E. Brant and Sidney S. Stahl.

**John C. Kupferle Foundry Co.,** St. Louis, Mo., incorporated to take over the business of the late John C. Kupferle, manufacturer of hydrants and other water and plumbing supplies.

**Evans Plumbing & Heating Co.,** Evans, Ill., capital $8,000, heating and plumbing contractor, succeeding Evans & Hoefer. Incorporators, T. E. Beck, Charles E. Evans and William B. Holmes, all of Freeport.

**Glose Heat & Power Co.**, Guthrie and Chicago. Capital stock, $10,000. Directors: J. J. Butler, G. A. Mason and F. E. Maeum, of Chicago; and G. V. Pattison and H. W. Pentecost, of Guthrie.

**Demarest Heater Co.**, Springfield, Mass. Capital stock, $15,000. Incorporators: John Demarest, Edwin S. Stacy and Richard H. Stacy.

**Peck, Anderson & Peck Co.**, Cincinnati, O., capital $50,000, to conduct a general heating business. Incorporators: John K. and Robert E. Peck, formerly of the Peck-Williamson Co.; A. J. Anderson, formerly vice-president of the John McWilliams Co., Louisville; L. D. Ault and Jackson Sparrow.

**Sandusky Plumbing & Boiler Co.**, Sandusky, O., capital $10,000, to enter heating and plumbing contracting business. Incorporators: M. A. Lea, John Traub, A. H. Knapp, Peter Full and M. A. Cooke.

**Haverstick & Co.**, 66-70 Exchange street, Rochester, N. Y., capital $50,000, to deal in engineers', steam fitters' and mill supplies. President, Franz Haverstick; secretary, Harvey E. Cory; treasurer, Henry D. Shields. Mr. Haverstick was formerly connected with the Western Tube Co.

**National Valve Co.**, Baltimore, Md., capital $125,000, to manufacture valves and plumbing supplies. Incorporators: Chas. A. Parks, W. M. Cary and A. P. Smith, of Baltimore; John R. Turner, Jersey City.

**Hughes Heating & Plumbing Co.**, Minneapolis, Minn. Capital stock, $20,000.

**Wright, Alexander & Co.**, Rochester, N. Y., heating and plumbing contractors. Capital stock, $75,000.

**Sidney Valve & Supply Co.**, Sidney, N. Y., capital $26,000, to manufacture valves and other heating and plumbing supplies. Incorporators: George Wilkinson, Frank H. Smith and Robert Cartwright, all of Sidney.

**Thomas & Smith**, manufacturers of the Acme air washer and purifier, incorporated with a capital of $110,000. Incorporators: Richard H. Thomas, Andrew Kilander and John T. Booz.

**Bay State Heating Co.**, South Berwick, Me., capital $10,000, to conduct general heating business. President, Fred A. Hobbe; treasurer, William Thompson.

**Frank L. Patterson & Co.**, New York, capital $20,000, to manufacture feed water heaters and other steam specialties. Directors: Frank L. Patterson and Arthur B. Grotz, New York; Isaac M. Patterson, Trenton, N. J. The firm purchased the patents of the Ferguson feed water heater, formerly manufactured by the Ferguson Co.

**Gallaway & Geiss Plumbing & Heating Co.**, Kansas City, Mo. Incorporators: William T. Gallaway, Louis N. Geiss and May A. Gallaway.

**J. H. Knudsen Plumbing Co.**, Carthage, Mo., capital $10,000, to continue heating and plumbing business now conducted under that name. Incorporators: J. H. Knudsen, William Hyde and Edward Heck.

**Knickerbocker Valve Co.**, New York. Capital, $5,000. Incorporators: George L. Hall, B. H. Leather and Andrew Riley, all of New York.

**Wildman Boiler Works**, 1278 West Twelfth street, Chicago. Capital stock, $25,000.

**Smith Automatic Valve Co.**, Boston, Mass. Capital, $60,000. Incorporators: Angus J. Smith, Daniel Livingston and Jonathan Perry.

**Glassaway & Geise Plumbing & Heating Co.**, Kansas City, Mo.

**Sanitary Heating Co.**, Brooklyn, N. Y. Capital stock, $400,000. Directors: William H. Schofield, William J. Wilson, F. L. Hulse and F. L. Sheffey, all of New York; William E. Wilson and Frederick R. Wilson, of Brooklyn.

**Standard Plumbing Co.**, Akron, O., capital $5,000, to conduct a heating and plumbing business. Incorporators: Frank E. Chalker, John C. Klein, H. C. Knecht, Frank C. Schafer and Geo. W. Slutz.

**Ernest Hardware & Plumbing Co.**, Seattle, Wash. Capital stock, $100,000.

**Canton Valve & Mfg. Co.**, Canton, O. Capital stock, $10,000. Incorporators: James L. Amerman and others.

**Tofte Boiler & Sheet Iron Works**, Houston, Tex. Capital stock, $40,000. Incorporators: H. H. Tofte, Frank Wilberg and W. E. Nicholson.

## Business Chances

**Washington, D. C.**—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following-named work:

Until June 17, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Newton, Kan.

Until May 25, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Chester, S. C.

Until May 26, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Florence, Ala.

Until May 28, 1908, for the construction (including plumbing, heating apparatus, electric conduits and wiring) of

the U. S. Post Office and Court House at Houston, Texas.

Until June 1, 1908, for the construction (complete) of the U. S. Post Office and Court House at Grand Island, Neb.

Until June 2, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at New Ulm, Minn.

Until June 3, 1908, for the extension, remodeling, etc. (except elevator and lifts), of the U. S. Post Office and Court House at Detroit, Mich.

Until June 8, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Dover, N. H.

Until June 12, 1908, for the construction (complete) of the U. S. Post Office at St. Charles, Mo.

Until June 9, 1908, for the low pressure steam apparatus for the extension to the U. S. Post Office and Court House at Ogden, Utah.

**Milwaukee, Wis.**—At a meeting of the building committee of the Milwaukee Auditorium Association, April 7, it was decided to recommend that the board of directors make the necessary appropriation for the installation of an independent heating plant.

**St. Paul, Minn.**—After an inspection of the State Normal School building at Mankato by the local fire investigating committee, the committee recommended that a number of wooden air ducts extending from the basement to the top of the building be removed, and that a separate building for the heating plant for the entire school be constructed.

**Lansing, Mich.** Heating and plumbing plans for the Larch Street School building have been drawn and will be examined by T. S. Ainge, sanitary engineer of the State Board of Health, after which bids for the work will be received.

**Marion, Ind.**—Governor Steele, of the Marion Soldiers' Home, is authority for the statement that by July 1 improvements, aggregating $15,000, will have been made to the Home grounds. The improvements include several changes in the heating system, an enlargement of the piping and the sinking of the underground pipe conduits to a greater depth.

**Madison, Wis.**—The executive committee of the Capitol Commission has adopted Architect Porter's plans for the heating plant to be erected on the Snell property. The building will cost $100,000.

**Marquette, Mich.**—The board of education has decided to place the heating plant for the new high school in a separate building, between the new and Case street structures. Three large boilers will be installed. J. D. Chubb is the architect.

**Vicksburg, Miss.**—The board of trustees of the Agricultural and Mechanical College will receive bids up to May 31, 1908, for the construction (including heating, plumbing, wiring and furnishings) of the new chapel and academic building, to cost not exceeding $100,000.

## Contracts Awarded

**McKay Heating and Plumbing Co.,** Erie, Pa., heating and ventilating system for new high school building in Erie. Its bid was $16,850. The successful bidders will be associated with the Foster & Glidden Engineering Co., Buffalo, in the execution of the work. The system will replace the Smead heating and ventilating system now in use.

**Columbus Heating & Ventilating Co.,** Columbus, O., heating new school building for $4,853.

**Lipsett & Sinclair,** Marquette, Mich., and Lake Superior Steam Heating Co., Ishpeming, Mich., steam heating plant at the normal school at Ypsilanti. Lipsett & Sinclair will build the power house, smoke stack and tunnels, while the Lake Superior Steam Heating Co. will install the boilers, pumps, piping and other equipment. The plant will cost about $30,000.

**E. J. Edbelding,** Augusta, Ga., heating, ventilating and plumbing Y. M. C. A. building in Savannah.

**Lewis & Kitchen,** Chicago and Kansas City, were the lowest bidders, at $9,000, for the construction of the heating plant for the government building at Green Bay, Wis. This firm was also awarded the contract for the heating plant of the Auditorium building, in Kansas City. Their bid was $13,728. Other bids were as follows: M. J. Donegan, $17,907.75; C. F. Rock Plumbing & Heating Co., $18,342; Urbauer & Atwood, $17,996.

**Phoenix Heating & Sprinkling Co.,** Grand Rapids, Mich., overhead tank water fire protection system for County Home at Grand Rapids. Its bid was $6,170.

**O. A. Toulle,** Terre Haute, Ind., heating new Greenwood School building for $3,700.

**Hiborn & Faulkner,** Bucyrus, O., steam heating and plumbing public school building in that city for $3,000.

**Cook Bros.,** Indianapolis, Ind., heating new Terre Haute Trust Co. building for $10,700. Prox & Burgett have the plumbing contract at $9,247.25.

**J. J. Madigan,** Dallas, Texas, heating and plumbing Epileptic Colony building at Abilene, Texas, for $5,197; also heating and plumbing $50,000 building for the Winfield Scott estate.

**Western Plumbing & Heating Co.,** Omaha, Neb., heating and plumbing the new Nansen restaurant for $9,000.

**J. J. Hanighen,** Omaha, Neb., heating and plumbing new building at Fort Robinson for $4,500.

**Johnson-Rowe-Daly Co.,** Omaha, Neb., heating and plumbing post office at Peoria, Ill., for $20,000; also heating and plumbing buildings at Fort D. A. Russell, Wyo., for $35,000.

**Theo. M. Barr,** Salem, Ore., heating and plumbing new Southern Pacific Railway station at Eugene, Ore.

**W. A. Chesterman,** Richmond, Va., construction of Branch Public Baths in Richmond. The baths will cost $26,000 and will accommodate at one time 2,000 persons.

**Henry Niemes,** Cincinnati, O., steam heating public comfort station in Fountain Square, that city, for $1,290.

**S. A. Westhaven,** Martinsburg, W. Va., steam heating, plumbing and electric wiring for new Y. M. C. A. building at that place.

**Columbus Heating & Ventilating Co.,** Columbus, O., heating new school building at Moundsville, W. Va., for $4,853.

**Jones, Koehule & Co.,** Lincoln, Ill., heating and plumbing gymnasium building of the Illinois Asylum for Feeble Minded at Lincoln for $2,500; also heating Pythian Home at Decatur.

**Dewstoe & Brainerd Co.,** Cleveland, O., heating, ventilating and plumbing new post office in that city. The contracts total $100,000.

**Armitage Bros.,** New Kensington, Pa., steam heating business and apartment building for David Thomas.

**Baker, Smith & Co.,** Pittsburg, Pa., steam heating system for $1,000,000 Soldiers' Memorial Hall now being built at that place.

**Westinghouse, Church, Kerr & Co.,** Pittsburg, Pa., steam heating new addition to the South Side Hospital, Pittsburg.

**M. B. Sanders,** Little Rock, Ark., fire protection sprinkler system in the Arkansas Hospital for Nervous Diseases.

**A. V. Rogoski,** Little Rock, Ark., heating and plumbing new Masonic Orphans' Home at Batesville, Ark.

**Albert B. Franklin,** Boston, Mass., and Isaac Coffin Co., also of Boston, were the lowest bidders at $9,971 and $9,728 (second bid) respectively, for the heating and ventilating of the Melrose high school building.

**Bayley Heating Co.,** Milwaukee, Wis., steam heating apartment building being built by John Hunholz.

**Grand Forks Heating & Plumbing Co.,** Grand Forks, N. D., heating and plumbing new Roman Catholic Church at that place for $4,500.

**Downey & Kruse Co.,** Milwaukee, Wis., heating La Crosse normal school for $22,717. Kavanagh & Smith have the plumbing contract at $9,894.

**A. J. Lindemann & Hoverson Co.,** Milwaukee, Wis., heating new Milwaukee normal school for $20,279. The plumbing contract, amounting to $8,350, went to Joseph Wittig.

**T. S. Wilcox Plumbing Supply Co.,** Chattanooga, Tenn., heating Y. M. C. A. building in that city for $5,433.75. The William Attlessly Co., Cincinnati, is doing the plumbing.

**Huffman-Connolly Co.,** Cincinnati, O., steam heating new Southern Railway station at Chattanooga.

**Otis Engineering Co.,** Oswego, N. Y., heating and ventilating new school building at that place for $2,000.

**Thomas E. Gildea,** Syracuse, N. Y., heating Homeopathic Hospital in that place for $7,000.

**Gunster Bros.,** Scranton, Pa., heating and plumbing stations of the D., L. & W. R. R. at Scranton ($40,000), and at Ampere ($4,500); also heating Y. M. C. A. building at Berwick, Pa., for $8,500, and Masonic Temple at Sunbury, Pa., for $2,700.

**W. S. Patterson Co.,** Appleton, Wis., heating new dormitory building for the State School of the Deaf at Delavan, Wis.

**W. J. Chambers,** York, Neb., heating and plumbing new Elks' Club.

**Eschle Heating & Plumbing Co.,** Bozeman, Mont., heating and plumbing the Agricultural College buildings at that place.

**F. L. Haertle,** Neenah, Wis., heating and plumbing telephone building at that place.

**Nelson & Anderson,** Red Wing, Minn., heating Lutheran Seminary at that place.

**Cragen, Wilkins Co.,** Leominster, Mass., installing new blower system in chair factory of Conant & Ball at Gardner.

**Steward Hardware & Plumbing Co.,** Skowhegan, Me., heating and plumbing new city building.

**Noll Bros. Co.,** Poughkeepsie, N. Y., heating and plumbing new fire department building at that place.

**George H. Soffel Co.,** Pittsburg, Pa., steam heating and plumbing new quarters of the Fort Pitt Athletic Club in the Manufacturers' building.

**Frank Holt,** Pittsburg, Pa., hot water heating double residence at Bellevue, Pa., for Clarence B. Johnston.

**Lincoln Plumbing & Heating Co.,** Pittsburg, steam heating business and apartment building for S. S. Little.

**O'Toole Bros.,** Clinton, Mass., steam heating Crossman block.

**Thomas J. Sheehan,** St. Louis, Mo., steam heating and plumbing new Maryland Hotel.

**M. D. Holmes,** Worcester, Mass., steam fitting and plumbing wire factory on Millbury street, and factory on West Boyleston street.

**W. B. White,** Monesson, Pa., remodeling steam heating system in the White block at Monongahela, Pa.

**American Warming & Ventilating Co.,** Pittsburg, Pa., heating high school building at Scottdale, Pa., for $4,700.

**W. D. Allen,** Seattle, Wash., heating and ventilating new municipal building at Seattle for $22,514. Rautman Plumbing & Heating Co. has the plumbing at $17,576.

**W. J. Scholl Co.,** Youngstown, O., heating and plumbing the new Mahoning County Court House at Youngstown at its bid of $70,000.

**Ideal Heating & Construction Co.,** Davenport, Ia., steam heating new office building of the Bettendorf Axle Co.

**Miles & Ulmer,** Terry, Mont., heating new building of the Terry Drug Co.

**John G. Sutton Co.,** San Francisco, Cal., plumbing, heating and ventilating and lighting Southern Pacific Railway Co.'s new hospital for $43,320.

**Savage & Adair,** Reno, Nev., steam heating Winnemucca jail, at Winnimucka, Nev.

**G. E. Witt Co.,** San Francisco, Cal., heating and drying systems in building of the Goodyear Rubber Co.

**Swanson & Peterson,** San Francisco, Cal., heating and electric lighting of Western Hotel at Eureka, Cal.

**Louis B. Scheible & Sons,** Youngstown, O., heating and plumbing Central Union Telephone Co.'s building in Youngstown.

**McGinness-Smith Co.,** Pittsburg, heating new Second Ward school at Indiana, Pa., for $9,507.

**Twentieth Century Heating & Ventilating Co.,** Akron, O., heating T. S. Riley's new $30,000 residence at Wheeling, W. Va.

**Smith, Hutton & Kirk,** New Castle, Pa., steam heating National Bank of Lawrence County.

**O. S. Kendall & Son,** Worcester, Mass., heating and plumbing new wing of the Herbert Hall Hospital.

**Jennison Co.,** Fitchburg, Mass., plumbing, heating and sprinkling systems in the Shirrefs Worsted Co.'s new mill.

**Wilbur I. Steele Co.,** Hartford, Conn., heating Sherman Land Co.'s houses at New Britain.

**F. A. Carleton Co.,** New Haven, Conn., heating and plumbing buildings of the New Haven Window Shade Co.

**Kehoe & Metz,** Newark, N. J., heating and plumbing new factory building for the B. M. Shanley Co.

**McGinness-Smith Co.,** Pittsburg, Pa., hot water heating system for Charles Lang's $20,000 residence at Carrick, Pa. American radiation will be used.

**P. F. Maginn & Co.,** Pittsburg, Pa., hot water heating $12,000 residence at McDonald, Pa.

**Baker-Smith & Co.,** Pittsburg, Pa., hot water heating system for new laundry building, at Reed and Miller streets, for the Passavant Hospital.

**S. A. Westhaven,** Martinsburg, W. Va., heating, plumbing and electric wiring for new Y. M. C. A. building in that city.

**C. C. Workman,** Parsons, Kan., heating, plumbing and electric wiring for new First Baptist Church in that place.

**Sioux Hardware & Construction Co.,** Dell Rapids, S. D., heating and plumbing Dells Hotel.

**W. J. Chambers,** York, Neb., heating and plumbing Elk's Club at that point.

**Tom Wilcox Plumbing Co.,** Chattanooga, Tenn., heating Y. M. C. A. building in that city. Wm. Attlesey Plumbing Co., Cincinnati, has the plumbing contract.

**Urbauer & Atwood Heating Co.,** St. Louis, Mo., steam heating new Hotel Buchanan at St. Joseph, Mo. William Burke, St. Louis, has the plumbing contract, which is a large one.

**Daniel J. Whooley,** Fitchburg, Mass., steam heating and plumbing St. Augustine's Church in Fitchburg.

**West Virginia Plumbing & Heating Co.,** Charleston, W. Va., hot water heating and plumbing for new residence for David Dick in that city.

**American Warming & Ventilating Co.,** Pittsburg, heating and ventilating new high school at Mt. Pleasant, Pa.; also heating plant for new $1,000,000 Mahoning County Court House at Youngstown, O.

**Lewis & Kitchen,** Kansas City, Mo., heating, ventilating and plumbing Central Park School in Topeka, for $10,000.

**H. A. Hildebrandt,** hot water heating new hospital at Aurora, Minn.

**W. H. Porter,** Newhawka, Neb., hot water heating Newhawka Bank.

**J. H. Wiggins,** Willmar, Minn., heating and plumbing new school at Lake Wilson, Minn.

**Hiborn & Faulkner,** Bucyrus, O., hot water heating and plumbing public school for $3,000.

**Alexander Roanoke,** Oakmont, Pa., steam heating and plumbing McCurdy building.

**M. J. Gibbons,** Dayton, O., heating and ventilating new Memorial Hall, at Dayton. The contract amounts to $10,000.

**W. B. White,** Monongahela, Pa., steam heating business block at Monessen.

**Smith, Hutton & Kirk,** New Castle, Pa., heating National Bank of Lawrence County.

**Youngstown Sheet & Tube Co.,** Youngstown, O., has contract for furnishing 58,000 lineal feet of galvanized iron pipe of different sizes, 85,300 lineal feet of black iron pipe, and 48,400 lineal feet of extra heavy wrought-iron pipe. The company's bid was $45,628.

**California Hydraulic Engineering & Supply Co.,** San Francisco, Cal., steam heating 14-story for A. P. Sullivan for $9,890.

**Coonan's Eagle Cornice Works,** San Francisco, Cal., heating Sunnyside School for $4,497.

**John G. Sutton & Co.,** San Francisco, Cal., steam heating Hibernia Bank building.

**Jones & Hopkins,** Nashville, Tenn., heating McKendree Church for $2,000.

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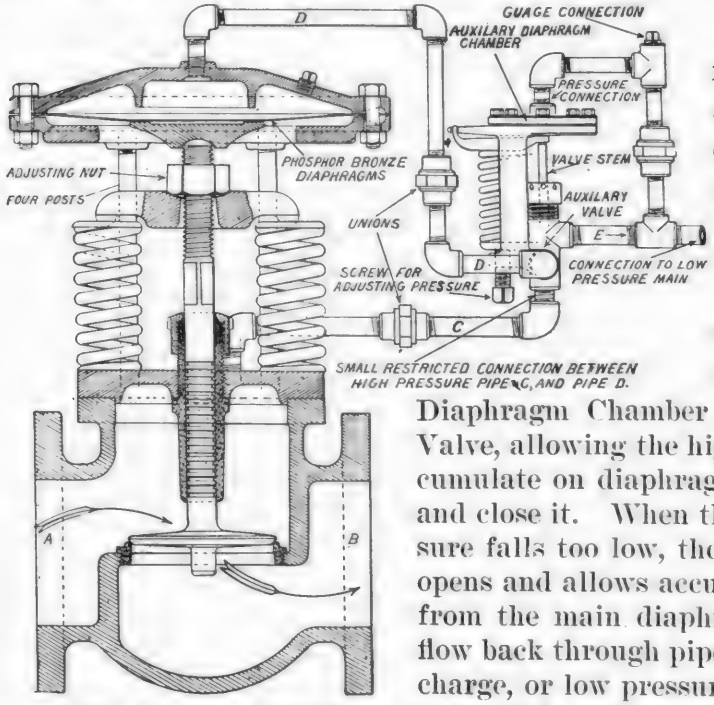


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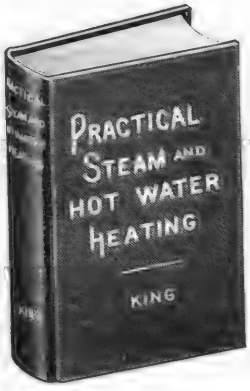


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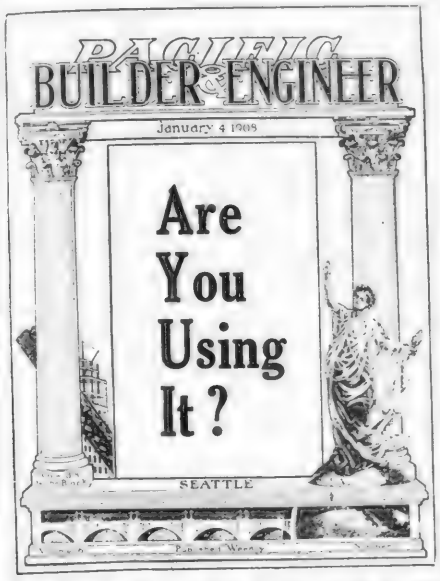


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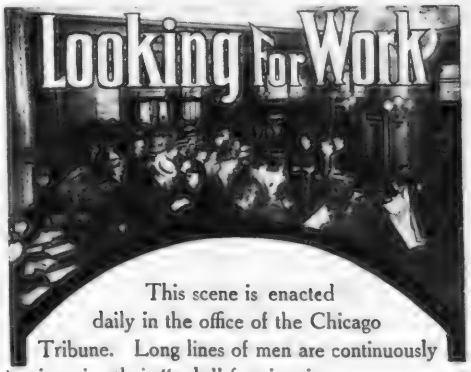


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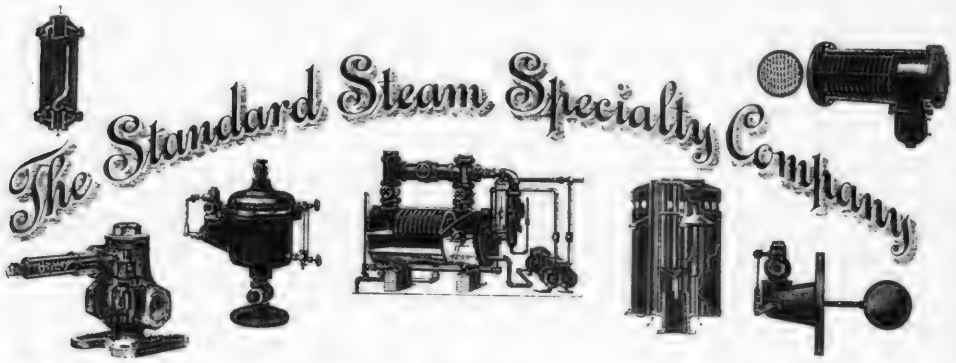


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